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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Solvents in Industry

The extended use of solvents in industry, as it is understood to-day, developed during the war and post-war period. In the old days, of course, chemists were familiar with the use in this field of benzol, toluol, acetone, and similar agents, but with the development of nitrocellulose chemistry there has been an enormous development in the number of agents employed as solvents, in the variety of their industrial applications, and also in the processes for solvent recovery after use. The charts we reproduce in this issue, by permission of British Industrial Solvents, Ltd., and the Methylating Co., Ltd., enable one to visualise at a glance the almost bewildering developments that have occurred in this field, and the extent to which they have operated in the output of new products of commerce.

We are fortunate to have contributions by some of the leading experts in this highly specialised branch of industrial chemistry. Mr. Jas. MacGregor writes with his usual authority on the use of trichlorethylene in solvent extraction, and his notes on the characteristics of the plant and process will be widely appreciated. Mr. J. Arthur Reavell treats with similar knowledge

and experience the intricate problem of solvent recovery. Solvents and plasticisers are discussed by Dr. T. H. Durrans, and other contributions deal with the uses of Silica Gel and Acticarbone in solvent recovery, cyclohexanol and its derivatives, the range of non-inflammable solvents manufactured by Imperial Chemical Industries, solvent recovery by condensation, the filtration of recovered solvents, and other aspects. These notes, contributed by authorities in their respective branches, not only emphasise the importance of the solvents industry but contain valuable judgments and experience on the technical problems involved.

War Debts Moratorium

To no industry is President Hoover's proposal for a twelve-months' war debts moratorium of more interest than to the British chemical industry. One of its main purposes is to save Central Europe, especially Germany, from economic collapse. Some short-sighted and superficial observers may see in it nothing more than help for Germany as a future competitor; what, apparently, they do not see is that a collapse in Central Europe would have disastrous consequences, not only for the countries immediately concerned, but for the other nations linked up with them in finance and industry. If the United States, separated by the Atlantic from our troubles in Europe, feels that it cannot afford to let matters drift too far, more than ever should we be anxious to assist in the attainment of the objects that President Hoover has in view.

The biggest thing in the financial history of the world—that was the opinion of the City of London after a week-end's reflection on the Hoover pronouncement. The President of the United States is the most powerful individual in the world. and Mr. Hoover has added to the great traditions of his office by making an historic declaration that ends the Great War period as effectually as the Kaiser's ultimatum in 1914 began it. The next few weeks may witness numerous efforts on the part of the experts to complicate the simple issue, but the facts remain as easy as any facts can be, and in this case they are big facts, not petty political particulars.

The story begins with the Peace Conference of 1919, when the victors in their madness talked of £250,000,000,000 as the total of the bill for reparations. That was the big and fatal blunder. Nothing of the kind had ever happened in the history of the world before, and, needless to say, nothing like the sum mentioned came within the reach of practical possibility. But the Allies in their power had forced into the ledgers of the world this fantastic bogy of hundreds of thousands of millions. Various conferences have from time to time adjusted the figure downwards, but for twelve years every action of every individual in the world has been adversely affected by the con-

tinued existence of huge sums of false political currency, and business has thus become more and more difficult.

President Hoover has cut this knot, and has done it with characteristic American courage. The American position on which the President has made his offer is full of lessons for the rest of us. The American Treasury has a deficit of £200,000,000 sterling, and vet the President proposes to forgo some £48,000,000 of foreign receipts. On the face of it this looks like madness. But the Americans have come to realise far quicker than the rest of us that all this spurious money in the hands of governments is a danger and not a blessing. This attempt on their part to implement the absurd provisions of the Versailles Treaty has thrown the world out of work, and America is not accustomed to being without employment. The Balfour Note very wisely provided years ago that we as a nation would collect no money out of our victory. America is years later coming to our view. The practical complications, the fact that we are nominally debtors to America, and that we have to collect from other countries are insignificant beside the bigger fact of the recognition by the United States of the folly of all this business. Mr. Hoover, for the moment, gives us a moratorium, and it would be unwise to carry the discussion much beyond that point at this early juncture. But whether we call it a moratorium or provisional cancellation, it makes no difference to the vital recognition of the truth which every business man has always known—that inter-governmental debts have no place in a sound financial system.

Copper Sulphate Production

RUMOURS have apparently been in circulation recently in the trade that the Mond Nickel Co., who have been for many years the largest producers of copper sulphate in the United Kingdom, have decided to abandon its manufacture. We have the best authority for stating that there is no foundation for these rumours, which probably originated in the fact that during the year, from June, 1930, to June, 1931, the quantity made was small. The restriction during this period was due to the accumulation of a considerable stock which it was decided to liquidate. During the past few months, experiments have been completed which will simplify and cheapen the production of copper sulphate in future, and the Mond Nickel Co. intend to produce such quantity as is found to be to its advantage. The maximum capacity of the plants when reconstructed will be in the neighbourhood of 50,000 tons of copper sulphate, but it is not intended, at least at first, to work up to this capacity.

Copper sulphate is, of course, an important byproduct in the company's manufacture of nickel. As a consequence of the improvements the Mond Nickel Co. will be able to meet the increasing demand for both large and small crystals of their well-known "Maple" brand copper sulphate. This has established a high standard all over the world because of its wellknown quality. It is guaranteed 98/100 per cent. pure and the crystals are noted for their unusually large size and deep blue colour. This copper sulphate is greatly in demand with the agricultural communities, especially of Southern Europe and the Near East, and of certain countries in South America where it is used

by all interested in the wine, dried fruit, and currant industries. The powder (or "snow") is largely used in the preparation of Burgundy or Bordeaux mixtures in France, while the small crystals, commonly called "menus," are also produced.

Sugar in the Oven

THERE is sugar enough in the world made, so to speak, by sunlight at almost no price, and costing relatively little to extract and purify. The sugars have long formed one of the most entrancing fields of chemical speculation in regard to structure; we have learned so much by their study even though the synthesis of cane sugar itself still eludes us. Its constituent sugars, glucose and fructose, or dextrose and lævulose, as the Chemical Society will have us call them, are becoming of increasing importance—glucose as a non-sweetening ingredient in ice-creams, fructose as a more tolerable food in abnormal sugar metabolism.

In the body all sorts of substances are picked up by glucose and attached to it at the aldehyde end, whilst at the same time the far end is oxidised to carboxylic acid. Such compounds, the glucuronates, are receiving increasing study, particularly since their importance as constituents of pectins and their wide presence in plants are realised. In the laboratory the oxidation of glucose goes in quite another way, the aldehyde group being oxidised to gluconic acid. This compound has been known for a long time, but it was never dreamed that it would be promoted to a position of industrial importance. Yet this appears to have happened, for the acid and its lactone have been found to possess very valuable properties as the acid ingredients of baking powders. Vis-à-vis tartaric acid, they score in mainly coming into action when the cakes or biscuits are hot in the oven.

In a country like the U.S.A., where baking powders are consumed in tens of thousands of tons annually, there is a knowledge of the finer points and subtleties of "rising" flour which we do not possess, but we are assured that gluconic lactone stands high in the scale with connoisseurs. It is made for this purpose, not by the cruder methods of the chemist, but by a mould of the same type as the organism which transforms sucrose into citric acid with an ease and at a price which is the envy of the lemon. True, the mould is docile in the hands of one of our kind, the biochemist, and it is whispered also that electrolytic oxidation of glucose is a competitive method of obtaining gluconic acid. So the chemist has his share in the achievement.

The Calendar

July		
13	Chemical Plant and Research Instru- ments Exhibition: Opening 11.30 a.m.	Central Hall, West- minster, London.
14	Annual General Meeting. Presidential Address by Sir Harry McGowan. 10.30 a.m.	Royal Academy of Music, Marylebone, London.
14	"Recent Developments of the Society of Chemical Industry in Basle." Dr. G. Engi. 7 p.m.	Salters' Hall, St. Swithin's Lane, London.
15	Presentation of Society's Medal to Dr. Herbert Levinstein. 10.30	Royal Academy of Music, London.
15	Annual Dinner, 7 p.m	Wharncliffe Rooms.

harncliffe Rooms, Great Central Hotel, London.

Concerning Solvents and Plasticisers By Thos. H. Durrans, D.Sc., F.I.C.

Dr. T. H. Durrans is Chief of the Research Laboratories of A. Boake, Roberts and Co., Ltd., chemical manufacturers, of Stratford, London, E.15, and author of a Monograph of Solvents, which is now in its second edition.

In view of the large number of solvents which are now available industrially, it is remarkable how consistently the demand is limited to a comparatively few. The world's consumption of solvents has been estimated now to be in the region of 100,000 tons annually, but acetone, ethyl acetate, butyl acetate and amyl acetate still hold pre-eminent position as cellulose ester solvents and are only seriously threatened by the glycol ethers. Certain solvents have not been so successful as expected-namely, the hydrogenated phenols, diacetone alcohol, higher ketones and furfural, in spite of much patient work, although for certain purposes they undoubtedly possess advantages over the more commonly used solvents. It is also interesting to note that the pride of place still belongs to solvents produced by the aid of bacteria, although purely synthetical methods are likely to replace fermentation processes to a large extent. There have recently been striking technical advances in both synthetical and fermentation processes, outputs and efficiencies having been increased and products of greater purity obtained.

The Function of Plasticisers

Not only has the number of commonly used solvents been limited to a comparatively few, but the range of commonly used plasticisers and resins has also been severely limited. The main consumption of plasticisers is confined to triacetin, benzyl alcohol, triphenyl phosphate, tricresyl phosphate and the phthalic esters, while ester gum and its derivatives are still the only resins which find a universal application in cellulose lacquers. It is not easy to decide whether this is due to a state of stagnation or of stability in lacquer manufacture, but it would appear that to some extent the technical manufacture of lacquers has gone as far as the science of the subject has permitted. The modern lacquer has undoubtedly reached a high state of perfection, and its wide use is evidence that it fulfils its function efficiently; yet every manufacturer is aware that it lacks somewhat in certain properties, such as adhesion, permanency, flexibility and certainty in application.

While no great advance has been made for some years in the technical production of technically valuable solvents, It is rapidly being much work has been done on plasticisers. realised that the plasticiser plays a rôle of great importance in the production of films and that on the plasticiser and quality of the film depend to a very large extent. The plasticiser is veritably the master of the cellulose ester film and controls its career throughout its life. On the plasticiser largely depend the qualities of stability, permanence, elasticity, plasticity, compatibility and ease of application.

It is a curious fact that nearly all plasticisers belong to the ester class, and as a consequence a large number of chemical compounds are available for consideration. By varying the component parts of the ester it is possible to adjust the physical properties of the plasticiser, and the systematic study of these substances forms a field of scientific investigation of great interest. We are now beginning to understand the nature of the phenomena involved in plasticising cellulose esters and to realise that the subject is one of considerable complexity. A close study of plasticisers has been made during recent years by A. Boake Roberts and Co., Ltd., of London, £.15, and they have evolved a range known as "Abracols" having distinctive properties such as high plasticising power, lack of volatility, stability to climatic conditions and exceptional solvent powers, which render compatible one with another cellulose esters and ethers, gelatine, vinyl resins, glyptal resins, ester gums and other lacquer components.

Manufacturers of cellulose lacquers, both in this country and in the U.S.A., have recently been concerned with the question of flash points. It must be admitted that the present methods of determining flash points are quite unreliable and unsatisfactory, and until a really accurate method has been devised figures quoted for flash points can have but little significance. It has been proved that the present method in the hands of skilled observers gives results varying by as much as 8° F. The flash point of a lacquer must be regarded from two aspects, namely, its initial value and its value during application. It is relatively easy to impart a fictitiously high flash point to a lacquer before use by the addition of quite small amounts of non-inflammable highly volatile substances. Such a procedure may be of value during transport in bulk, but it is positively dangerous during the period in which the lacquer is being applied, since it gives a false sense of security; the security which has been obtained during transport being lost directly the non-flashing highly volatile ingredient has evaporated.

Unsuspected Toxic Properties

Another property which is receiving considerable attention is that of toxicity; and here the imposition of more stringent regulations is not improbable. The element of surprise is often present, for until recently glycol chlorhydrine had been regarded as harmless, but has now been found to be a very dangerous material possessing unsuspected toxic properties.

Advances have been recently made in the production of materials which aid the wettability of pigments by alteration of surface tensions, a new product in this connection being "Lesoil," which not only aids wetting but also permits a considerable economy of the oils with which pigments are ground. A kindred subject of interest to the oil, paint, and printing ink trades is that of metallic driers; the science of this subject is at present chaotic, but it is known that metallic driers have two functions, one being that of a purely gelling agent and the other that of a catalyst for the aerial oxidation the unsaturated oil ingredients of the paint or ink. customary to pay meticulous attention to the metal content of a drier, but this is largely a waste of energy, since the catalytic condition of the material is of vastly greater importance than the actual metal content. It should also be borne in mind that a drier should not dry in the absence of oxidisable material or, at any rate, only very slowly; to judge the quality of a drier, as is commonly done, by noting its consistency or its rapidity of drying in the unmixed state, leads to entirely erroneous conclusions, as these effects can readily be brought about by the addition of other materials which of themselves are valueless as drving agents.

Solvents from Corn Starch Fermentation Products of U.S. Origin

BUTANOL, acetone and methanol are the three primary products manufactured by the Commercial Solvents Corporation, of Aldwych House, London, W.C.2. Their works are in the United States at Terre Haute (Indiana) and Peoria (Illinois), at both of which places corn and coal, the principal raw materials, are available at favourable prices. A process of bacterial fermentation protected by patents controlled by the Corporation is utilised to convert the corn starch into butanol, acetone and ethyl alcohol. During the fermentation large volumes of carbon dioxide and hydrogen are evolved and these gases are transformed at high pressures into methanol. Carbon dioxide gas in excess of the amount required for the manufacture of methanol is delivered by pipe-line to an adjacent plant where it is converted into solid carbon dioxide, used as a refrigerant under the name of "dry-ice." Butanol, the principal product of the Corporation, finds its largest use in the manufacture of lacquer. Acetone is consumed in the manufacture of artificial silk, photographic films and for the storage of acetylene gas in cylinders; methanol is the basic material employed in the manufacture of formaldehyde, which is in turn necessary for the production of synthetic resins and many other plastics

The Commercial Solvents Corporation maintains extensive research laboratories for the purposes of widening the outlet for its existing products, and for the development of new processes and materials. Among the many derivatives of their primary chemical manufactures are butyl aldehyde, butyl acetate, dibutyl phthalate, butyl chloride, butyl stearate, butyl lactate, butyl acetyl ricinoleate, dibutyl tartrate, diacetone alcohol and monomethylamine.

Trichlorethylene in Solvent Extraction

By Jas. MacGregor

The author of this article, Mr. Jas. MacGregor, is managing director of George Scott and Son (London) Ltd., and Ernest Scott, and Co., Ltd., the well-known chemical engineers, who are to-day known, world wide, as Scotts of Silvertown.

The production of caustic soda and the chlorine incidental thereto by the electrolysis of common salt, the process employed in the manufacture of the bulk of the caustic soda of commerce, has brought trichlorethylene and other chlorine derivatives within the range of users of solvent extraction plants. A few years ago trichlorethylene—while appreciated by firms familiar with its excellent solvent properties and its other attractions, notably its non-inflammability—was ruled out on the ground of cost. As the consumption of chlorine products increases, the price of trichlorethylene and other chlorine derivatives will be proportionately reduced. Only the lack of a ready market for chlorine products retards the

production of caustic soda electrolytically on an increasingly extensive scale. While users of solvent extraction plants may, therefore, look forward to a time when it will be available at figures in the neighbourhood of the most widely used solvent, petroleum benzine, it is even at present-day prices commercially attractive.

The non-inflammability of trichlorethylene renders it possible to locate a solvent extraction plant at any point in a factory. In many processes solvent extraction is a link in a chain of operations, and where it is essential to convey the material in process to an isolated building (which is unavoidable if an inflammable solvent is employed unless the manufacturer is pared to incur all the risks and higher insurance premiums attached to the location of such a plant within the main factory) the conveying charges may prove an item of some importance. This may involve additional labour, in-

creased steam consumption, upkeep of conveying equipment, and added supervision, while in very large factories the difficulties attached to the fixing of conveyors or transporters may prove almost insurmountable.

Very frequently under such circumstances manufacturers have to rest content with some method of operation infinitely less efficient than solvent extraction. An excellent illustration of this is to be found in the large meat packing establishments. There the by-products are handled in various ways, dependent upon the purpose for which the fat produced is intended. At some stage of the operations a point is reached where steam digesting or dry rendering coupled with the use of hydraulic presses, expellers or centrifuges, have achieved all that is possible by mechanical means.

Where only technical fat is obtainable from pressing or centrifuging and, better still, when it is not desired or possible to produce other than technical fat from the raw material at any stage, solvent extraction is the ideal process. That has long been recognised and would have been more universally resorted to but for the difficulties already referred to. The fact that solvent plant using trichlorethylene may be placed right at the point of greatest usefulness opens up possibilities to the meat packer. This is merely a single example from many.

Users of solvent extraction plants realise the importance of what is known as a close range solvent, in other words, a solvent with a short distillation range. In trichlorethylene we have available a solvent with a constant boiling point. From this fact it follows that it is possible to more readily eliminate the solvent from the extracted residue and equally

from the mixed solvent and extract Surface evaporation in storage tanks need cause no concern, as it is possible to seal the solvent under a layer of water by reason of the higher specific gravity of the solvent. The presence of traces of solvent employed is usually detected by the plant operatives by The unmistakable and distinctive odour of trichlorethylene makes it possible to detect the faintest trace of this solvent. traces of solvent have, in certain processes, to be detected in presence of other odours coupled with steam. Even under such conditions the operator experiences no difficulty in determining the point of complete elimination.

As in the case of solvent plants where petroleum benzine is employed, plants for the use of trichlorethylene are too frequently assembled without much consideration of the problems associated with particular solvents. The greater cost of trichlorethylene as against



FIG. 1. PATENT S.C.K. SOLVENT EXTRACTION PLANT.

petroleum benzine demands efficient methods of obviating loss of solvent. Of particular interest, therefore, on the occasion of the Jubilee meeting of the Society of Chemical Industry, are two new designs which are being developed by Scotts of Silvertown who hold the exclusive rights under these patents. These plants, the Patent S.C.K. (Figs. 1 and 2) and S.B. (Fig. 3) have been designed for the use of trichlorethylene. The S.C.K. is adapted for the treatment of materials of low moisture content, and the S.B. for moist materials which lend themselves to treatment in stationary equipment.

The extractor of the S.C.K. plant is fitted with false bottom supporting, where necessary, a suitable mat. In the dome a water cooling coil is provided and below the false bottom, dry steam coil, separate water cooling coil, and open steam inlet. When the material to be treated has been charged into the extractor, the requisite volume of trichlorethylene, determined by experience, is introduced, and the dry steam coil brought into operation. The solvent vapour quickly

displaces the air to the condenser and the cock between the extractor and condenser is then closed. The water cooling coil in the dome is brought into play, which results in the material being subjected to the action of the solvent in vapour and hot liquid form. The extract is thus quickly removed, the drainage of the solvent from the mass being facilitated by employing the water cooling coil in the bottom of the vessel. On completion of extraction, the mass, heated to the temperature of the vapour of the solvent and drained of all liquid solvent, is subjected to a current of open dry steam. The solvent is rapidly eliminated and the material thereafter discharged in a hot state. If exposed in a thin layer any surplus moisture quickly evaporates.

moisture quickly evaporates.

In the small unit, Fig. 2, the extractor serves also as purifier or still. The facilities provided for creating a vacuum in the extractor permit of the mixed extract and solvent being returned thereto, a few minutes sufficing to remove the solvent from the extract, which may then be discharged, free from all traces

of solvent, into suitable vessels.

The S.B. design, Fig. 3, embodies the features of the S.C.K. coupled with a reflux condenser. The extractor is designed to operate at the desired pressure and after expelling the air is in direct communication with the reflux condenser. The reflux condenser is operated so as to maintain the desired pressure, thus ensuring the rapid evaporation of the moisture in the material in process. The receiver for the condensate is equipped with suitable inspection glasses. Provision is made for discharging the water from the surface of the condensate (water and

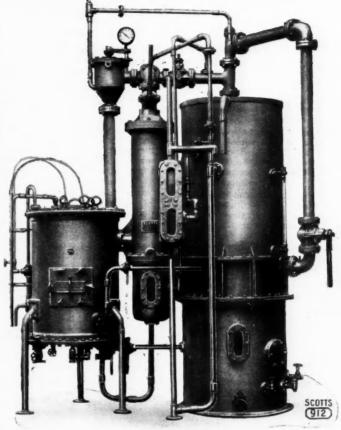


Fig. 3. Patent S.B. Solvent Extraction Plant for Dealing With Wet Materials Without Agitation.

solvent), automatically, to the main condenser. From this the water is in turn delivered to the final separator which serves as a perfect safeguard against the escape of solvent. The solvent is returned in a hot state to the extractor. For such materials as crushed green bones this S.B. plant is ideal. The features of this design will be appreciated by all concerned with the processing of bones and similar materials containing moisture which must be removed in effecting high efficiency extraction. Suitable provision is made in the form of scrubbers or a dsorbers for the recovery of traces of solvent from the air expelled from the plant.

A small S.B. unit will be exhibited on the stand to be occupied by Scotts of Silvertown at the forthcoming Chemical Plant Exhibition. Their catalogues dealing with these new solvent extraction plants and the many other types which Scotts have evolved

will be available to those interested.

Notes for Safety Organisers

BRIEF notes for safety organisers and safety committees in industrial concerns have been issued in booklet form by the National "Safety First" Association, of 119, Victoria Street, London, S.W.1 (price 1s.). These notes, which have been compiled by Mr. C. G. Ingall, one of the headquarters' safety engineers, are intended as an aid to efficiency in making inspections of departments, workshops, etc., giving an outline of the various points which a safety officer should be able to report upon. Against each of the items enumerated there are reference marks to indicate the frequency of inspection desirable, and this is a valuable feature of the notes considered as a whole.

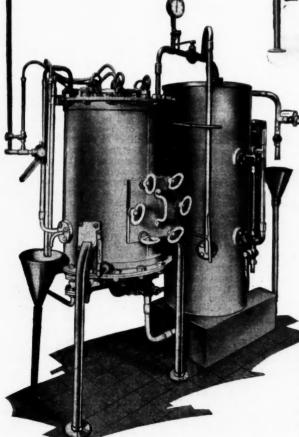


Fig. 2. Patent S.C.K. Solvent Extraction Plant Suitable for Small Users.

Non-Inflammable Solvents The Chlorine Derivatives of Ethane and Ethylene

The elimination of fire risks by the introduction of non-inflammable solvents has been an important development for the solvent-using industries. This article relates to a range of products which are being manufactured by Imperial Chemical Industries Ltd., and which are now finding extended use in oil extraction, dry cleaning, degreasing and textile scouring.

Though it is not necessary that a solvent should be non-inflammable it is impossible to exaggerate the importance of this property in a solvent that is otherwise completely successful. With the exception of dichlorethylene, the chlorine derivatives of ethane and ethylene are non-inflammable, non-combustible and non-explosive. They may, in fact, be used to extinguish fires. The hot vapours of dichlorethylene can be ignited and will burn with a cold flame but this will extinguish itself. There is consequently no risk of fire. These solvents have therefore the enormous advantages in commercial use that there are no vexatious restrictions upon their storage or transport. Fire insurance premiums are not increased, and there are none of those risks associated with the use of inflammable liquids.

While each of the series has its distinctive properties, there are other merits than non-inflammability which they have in common. They make for very efficient extraction, since they penetrate readily and the rate of solution of substances is very They are readily volatile and very easily condensed. Commercial dichlorethylene is a mixture of two stereo-Trichlorethylene, perchlorethylene and tetrasolutions are pure substances with no residue or "after smell." Pentachlorethane usually contains a trace of hexachlorethane. The first three are quite stable except when exposed to sunlight and may be used in contact with all common metals, even in the presence of moisture. chlorethane and pentachlorethane are stable in the absence of moisture, and in its presence in contact with lead or tin, but other metals reduce them to dichlorethylene and trichlore-thylene respectively. The boiling points of the series range from 55° to 159° C.—a range whose amplitude is not approached

by that of any other group of solvents. Oil Extraction

Trichlorethylene is the most important member of the group. It is almost the ideal solvent and may therefore be taken here to illustrate the commercial uses of the whole series, which have been manufactured on a large scale since 1903. chlorethylene has been used successfully for oil extraction for 20 years, during which time its manufacture has been greatly improved. Extraction gives valuable by-products and is therefore rapidly superseding the older methods of obtaining oils and fats from castor oil cake and fish meal, bones, the residues in slaughter-houses, and condemned animal carcases. It prevents the extraction by the oil itself of non-fat impuri-Extraction by trichlorethylene, moreover, gives oils that are free from the last traces of the solvent without undue heating and consequent damage. These may therefore be safely used in the manufacture of foodstuffs. The meal residue is also easily freed from the last traces of solvent and used in the preparation of compound meals and cattle cakes.

To obtain the maximum efficiency, the material to be extracted should be in the form of thin plates, flakes, shavings or threads, air should be removed from the material, and the plant should provide for the reversible circulation of the solvent. Most extractions are carried out with the aid of heat, the most suitable temperature being determined by experiment. Small quantities of trichlorethylene should be used often, rather than large quantities less frequently. It is not usually economical to remove the last 0.5 to 2 per cent. of oil from the residue. Extracted oils are refined in the same way as oils obtained by expression, either by charcoal or silicates.

Dry Cleaning

The non-inflammability of trichlorethylene readily explains the fact that this is replacing benzol and petroleum benzine for dry-cleaning. Very little alteration to the plant is necessary in order to enable trichlorethylene to be used, and there are economic advantages in the more efficient recovery of the solvent and in reduced steam consumption. Where a constant stream of goods passes through a dry cleaning works, the distillation residue is obtainable in marketable quantity, and may be sold for use in the manufacture of cheap greases and soaps.

Degreasing of Raw Wool

The degreasing of raw wool by means of solvents, which has been carried on with marked success in America for over 20 years, results, when trichlorethylene is used, in an improvement to all subsequent operations in the manufacture of woollen goods and to their finished feel and appearance. Many simple yet efficient degreasing plants have been designed, making use of the strong solvent action of trichlorethylene, for degreasing metallic parts in the engineering trade. Considerable economies are effected in the engineering workshops of railway companies, etc., by the degreasing of oil-saturated cleaning materials instead of burning them. Trichlorethylene is also used at tanneries for the removal of grease patches from hides.

Textile Scouring

It has been found that the detergent action of soaps in scouring textiles is enhanced by using solvents in conjunction with them and the great powers of penetration of trichlor-ethylene and the fact that it is non-inflammable make it ideal for this purpose. There are two kinds of trichlorethylene scourers used for textile scouring, both containing neutral soaps. One type (Westropol and Westrol) is soluble in water, the other (Westoran) forms stable emulsions with water. Westoran and Westrol are most suitable for scouring cotton, linen and jute, and Westoran and Westropol for woollens, worsteds, hosiery and woollen underwear. They will remove oils, fat and waxes and even obstinate tar stains.

Precautions in Use

The hygiene of works using chlorine solvents, as of all other solvents, is very important. The most important precaution is to prevent as far as possible the escape of vapour into the air; the next to provide efficient ventilation. These solvents are similar to chloroform in their tendency to induce intoxication and sleep when inhaled, although a large quantity is generally necessary to produce these effects. It is obvious that they should not be breathed continually, but when used in properly ventilated buildings they are perfectly safe. Whenever possible the solvent vapours should be removed at the point at which they are produced; otherwise by downward displacement, using suction fans either in the wall at floor level or in ducts under gratings in the floor. Care should also be taken to provide air inlets of sufficient area in the opposite side wall. Tetrachlorethane is an exception to the general class of chlorine solvents as it is toxic. Its use therefore is restricted by general consent to those special cases where its properties

make it essential, and where adequate precautions are taken. Dichlorethylene is most satisfactory for the extraction of delicate perfumes in the perfume industry, is the best solvent known for rubber, and is rapidly replacing ether for organic preparations in the laboratory. A dichlorethylene solution of iodine is used in the operating theatre for cleansing the skin. Its use for power production in multiple vapour power plants has been suggested and is now under investigation. In addition to the uses already given, trichlorethylene can be used for the solution of resins, tarry and bituminous products, india rubber and many organic substances, sulphur and phosphorus; the preparation of rubber-cements; and in the varnish, paint and lacquer industry. Perchlorethylene has similar properties. The pure substance is more expensive but is mixed with 50 per cent. or less trichlorethylene to produce a less volatile solvent.

Tetrachlorethane is the parent substance of these derivatives and the most powerful solvent of the series. It distils without decomposition, and is used as a solvent for all kinds of organic products, and as an insecticide. Pentachlorethane is similar and sometimes used to replace tetrachlorethane where a higher boiling point and lower volatility are required. Hexachlorethane is a solid which sublimes at 185° C. without melting, smells like camphor and is used for camphor in the celluloid industry. It is also used to render substances non-inflamable, for the preparation of safety explosives, smoke candles, as an insecticide, and incorporated in antifouling paints.

Some Aspects of Solvent Recovery By J. Arthur Reavell, M.I.Chem.E., M.I.Mech.E.

In a large number of the industries employing solvents the process involves the evaporation of the solvents. plant in which the solvent is evaporated varies with each particular application, but in general the solvent vapours leaving the plant are mixed with a relatively large volume of air. It is obviously of great economical import, therefore, that the evaporated solvent should not be passed to the atmosphere with the air, but should be recovered for further use. In a few cases it is possible to avoid large air volumes so that the solvent concentration is very high and it can be recovered by condensation in some form of condenser, utilising ordinary cooling water supply. Even after such condensation, however, the air that is passed to the atmosphere will contain the quantity of solvent corresponding to its saturation in air at the temperature to which the mixture is cooled, and it is frequently profitable to consider the recovery of this remaining portion of the solvent. The concentration, however, of the remaining solvent will, in general, be small and the principles of its recovery are very similar to that when large air volumes are used in the process of evaporation.

Various systems have been proposed and utilised for recovery of solvents from mixtures containing a relatively small percentage of solvent. These systems comprise condensation by refrigeration, absorption in wash oils or water, and absorption in solid absorbents. The use of solid absorbents such as Silica Gel or Carbon has increased enormously during the last few years, and whilst every recovery problem must be considered on its own merits, it may be said in general that the solid absorbent system is the best and most economic

method to adopt.

Final Treatment of Recovered Solvent

It is not the purpose of this article to discuss in detail absorption systems of recovery, but rather to consider the final treatment of the solvents after they have been recovered from the absorbent, which is usually carried out by heating with a direct current of steam. The solvent so obtained is thus mixed with the water arising from the steam used in its When a solvent is immiscible with water as, for removal. example, benzol, a simple gravity separation is sufficient to obtain the recovered benzol in a condition suitable for further use in the works.

There are a number of cases, however, where the solvent and water are completely or partly miscible, so that the final stage in the recovery process necessitates fractional distillation of the water from the solvent. This is not such a simple operation as may be imagined, because the rapid advancement that has been made in the commercial production of a variety of solvents has increased the use of mixed solvents which may thus involve the removal of water and the separation of the individual solvents from the solvent water mixture. should also be appreciated that the solvent water mixture will contain some 70 per cent. of water and that the solvents are required practically free from water. The fractional distillation involved is a matter of complexity partly because very little work has been done on the separation of the more recent types of solvent from each other and from water at the same time. A considerable amount of research must, therefore, be carried out before the requisite distillation plant can be designed.

The accompanying illustration Fig. 1 shows a typical Kestner continuous fractionating still, before erection, as used for the recovery of solvents. Fig. 2 shows a small Kestner fractionating still which is a very convenient unit for carrying out experiments on solvent recovery, being arranged so that it can be operated either as a continuous or batch still, and

also with direct or indirect heating

Removal of Dissolved Impurities

A different type of recovery problem arises in cases where the solvent in use has become impure through solid impurities, which are either dissolved or held in suspension as, for example, in the dry cleaning industry. In this case the recovery may generally be carried out by means of an evaporator as fractionation is not required, with the result that economy in the recovery operation may be effected by the use of a multiple effect evaporator.

In instances where very expensive solvents are employed, and the quantity to be dealt with is relatively small, the Kestner patent electrically-heated recovery plant has been found very efficient, in addition to which it has the great advantage of being so easily automatically controlled.

control can arranged, quired, so that the feed to the plant is automatic and is cut off when the boiling point of the distillate reaches a pre-determined figure. Automatic controls and special recording thermometers form a very essential part of any fractionating still, as the most efficient operation involves accurate control of feed, reflux, the cooling water, and steam temperatures of various plates. In a well-designed plant the various recording instruments and controls are located on one board and no labour is required when once the plant is started up, apart from periodical supervision checking of the recording charts.

It may be seen from the above

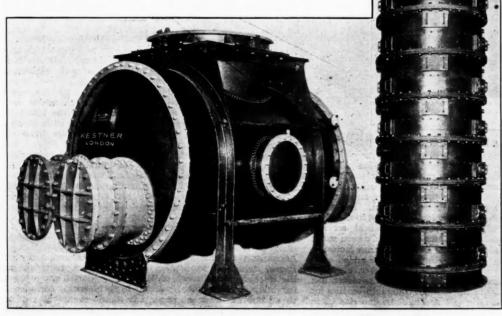


FIG. 1. KESTNER CONTINUOUS FRACTIONATING STILL FOR RECOVERY OF SOLVENTS (BEFORE ERECTION).

remarks that one phase of the solvent recovery problem may be divided into two stages, namely, absorption and subsequent separation of absorbed materials; whilst there has been considerable development in the processes and plant used for the first stage, not the least difficult part is the final recovery concerning which much development work is still necessary.

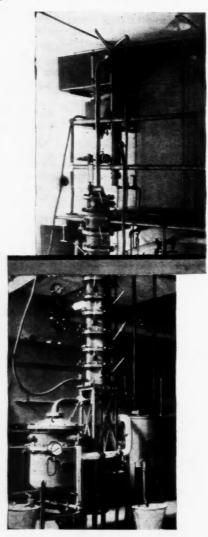


Fig. 2. Small Kestner Fractionating Still.

Quinine Production in India

Considerable attention has been given recently to the proposals of the Royal Agricultural Commission advising the formation of a cinchona department under the central government to coordinate the activities of the various Indian States in the production of cinchona and quinine and thereby more effectively cope with the malaria problem. It is considered essential to increase production of quinine to meet the added requirements of the government medical service. Material progress in cinchona planting has already been made in Madras. Bengal, and Burma and existing quinine factories, all government-operated, can, at relatively little added cost, amplify their output two or threefold. However, although the area planted to cinchona in India is quite considerable, much of it is still immature and will not come into bearing for several years; and difficulty will no doubt be experienced in maintaining present production with the current Indian crop. If further expanded activity is contemplated, importation of cinchona will still be necessary for some time.

Cyclohexanol and its Derivatives

A Range of Very Useful Solvents

CYCLOHEXANOL, methylcyclohexanol and their derivatives provide a highly useful variety of medium and high-boiling solvents and plasticizers for nitrocellulose, cellulose acetate, cellulose ethers, synthetic and natural resins, shellac, waxes, dyes, etc. These include "Sextone" (cyclohexanone), "Sextone B." (methylcyclohexanone), Cyclohexanol acetate pure, "Sextate" (methylcyclohexanol acetate), Cyclohexanol pure, "Sextol" (methylcyclohexanol), Cyclohexanol oxalate and "Barkite" (methylcyclohexanol oxalate). These solvents and plasticizers, which are manufactured by Howards and Sons, Ltd., of Ilford, are very stable products, practically non-inflammable, non-explosive, non-toxic and free from corrosive action on metals. They have exceptionally high solvent powers for synthetic and natural resins and good blending powers for cotton and resins and cotton and oils.

These solvents give excellent resistance to lacquers and impart good flow and high gloss. Barkite does not cause discolouration of white enamels; it imparts a particularly fine gloss to lacquer films. An improved quality of Sextone B. has recently been put on the market, having a higher evaporation rate than the previous quality; the ketone content is rather higher and the boiling-range appreciably narrower than in the case of the previous quality. Ethyl lactate and diacetone alcohol are two other useful medium and high-boiling solvents for cellulose esters, ethers, resins, etc.

Barkite has lately been used successfully in the varnish trade for preventing wrinkling in tung oil varnish films. Cyclohexanol and Sextol have widespread uses in the various branches of the textile trade. They are excellent solvents for fats, oils and waxes, and are particularly suitable for incorporation in soaps and other detergent preparations, emulsifying, dispersing and wetting-out agents. These two solvents and soaps containing them give excellent scouring results in the cotton, wool, silk, artificial silk and hosiery trades, and are also of great value to the dry-cleaning industry.

Cyclohexane is a colourless liquid with mild ethereal odour, very sharp boiling-point and extremely low solubility in water. For the above reasons its use is preferable to both benzol and special petrol cuts in the fine chemical industry, especially for recrystallisation purposes. It is also a valuable solvent for use in the extraction of essential oils. For both carnauba wax and paraffin wax it has exceptionally high solvent power.

Serious Explosion at Cordite Factory

A DISASTROUS explosion, involving serious loss of life, occurred on Tuesday last, June 23, at the Royal Naval Cordite Factory, at Holton Heath, near Wareham, Dorset. This factory, which was established during the war, employs between 1,400 and 1,600 people, who work chiefly in sheds which are isolated and protected by raised banks of earth. It was due to this form of protection that the fire following the explosion was prevented from spreading to adjacent buildings.

According to the official list of casualties, 10 men were killed and 3 were seriously injured; minor casualties are estimated to be about 20. Included among the killed is E. W. Blair, senior scientific officer and chemist-in-charge of the nitrating house; the remaining names are those of foremen, nitroglycerine and cordite workers.

It is understood that the explosion occurred in the nitrating house, originating just outside the house in a traverse or part of the space separating the building from the protecting banks of earth. In addition to the nitrating house, the washing house and distributing house were also destroyed, considerable damage being done in other directions by the terrific force of the explosion.

Chlorinated Calcium Hypochlorite

According to the United States Trade Commissioner at Rome, industrial application by the Società Elettrica ed Elettrochimica del Caffaro, of Milano, of a reported new process for producing chlorinated calcium hypochlorite is considered to be one of the most important recent events in Italian chemical circles. This process is said to involve the chlorination of lime in an immiscible solvent, carbon tetrachloride. The product is to be marked under the trade name of "Siclor."

Solvent Recovery by the Silica Gel Process

Its Advantages and Efficiency

The following details of the solid adsorbent known as Silica Gel, and its many advantages in solvent recovery, have been supplied by the technical department of Silica Gel, Ltd., of Bush House, Aldwych, London, W.C.2, who are sole representatives in Great Britain and the Colonies for the Silica Gel Corporation, of Baltimore, U.S.A.

Solvent recovery methods now in general use may be classified as those of absorption and adsorption. In the absorption processes the solvents are absorbed in liquids having boiling points higher than those of the solvent or solvents to be recovered. Not only must the scrubbing towers or washers in which the solvent mixture is treated be of the most efficient design, but the washing medium must be carefully selected to avoid chemical action taking place between it and the solvent. To recover the solvent from the washing medium the mixture is distilled indirectly with steam, and great care

must be exercised in the control of pressure and temperature so as to avoid possible chemical decomposition. Products of such decomposition naturally contaminate the recovered solvent, and may even make it unsuitable for reuse. The steam consumption is high; the equipment, consisting of washing towers, separating apparatus, and heat exchangers, is costly, and active control of the system is essential; the cost of the make-up quantities of the washing medium is also an important item.

Recovery by adsorption, on the other hand, is undertaken by means of materials possessing a highly porous structure giving them a large superficial area. Owing to the capillary and molecular attractions such materials exert they are capable of condensing even very dilute mixtures. They are comparatively inert, whereas practically all the washing or absorption media are relatively unstable chemical compounds, and the purely physical character of the adsorption process allows of the recovery of the solvent in a chemically unchanged form.

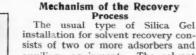
Advantages Gained by Use of Silica Gel

Silica Gel is produced by the mixing of water glass with an acid. After careful washing and drying of the gel thus formed, the resulting product is chemically identical with quartz, but has an ultra-microscopic porous structure which gives it a very high adsorption capacity. Silica Gel combines constant and maximum adsorption capacity with great mechanical strength, chemical inertness and incombustibility; its life is, therefore, practically unlimited. For industrial purposes it is normally used in granular form, offering but

little resistance to the flow of the solvent ai mixture.

As practically all solvents are inflammable the use of absorbents of an inflammable nature increases the dangers already present. In absorption processes condensation heat is released and the addition of atmospheric oxygen to combustible absorbents may easily give rise to spontaneous combustion. In addition to being incombustible, Silica Gel, thanks to its mechanical strength, does not powder, and therefore the risk of dust explosion is also eliminated. It can, furthermore, be heated to high temperatures with no deterioration in its adsorption capacity and efficiency. This is a quality of some importance since many solvent mixtures

contain traces of hydrocarbons with higher boiling points than those of the proper solvent. In the case of adsorbents other than Silica Gel the solvents adsorbed must be released or recovered by the direct application of low pressure steam, and this temperature is not high enough to remove such high boiling hydrocarbons. An accumulative clogging of the pores in such adsorbents consequently takes place, the capacity and efficiency of adsorption decrease and the recovery of solvent diminishes. The foregoing combination of qualities is possessed by no other solid adsorbent.

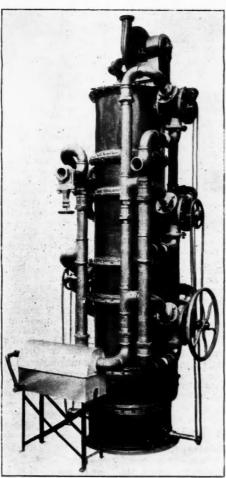


installation for solvent recovery consists of two or more adsorbers and auxiliary equipment. The solvent laden air may be first pre-cooled in a pre-cooler and thence conducted to one of the adsorbers. In this adsorber the solvent air mixture is stripped of the solvent and of any moisture which may be present. removal of moisture in addition to the extraction of solvent is an important factor, since many of the materials requiring solvents in their manufacture are highly sensitive to variations in the moisture content of the air. It is, therefore, a distinct advantage to obtain stripped air dehydrated by Silica Gel and to utilise it for conditioning the area in which the manufacturing process takes place, thereby improving working conditions.

While one adsorber is recovering solvent from the solvent-air mixture, the other adsorber or adsorbers are regenerated. The adsorbed solvents are displaced from the Silica Gel pores by passing steam at atmospheric pressure through the adsorbers. The steam and released solvent vapours are then conducted to the condenser and condensed. If the solvent is miscible in water the condensate is delivered to a still equipped with a rectifying column from which the uncontaminated solvent is obtained. If the solvent is not miscible in water it is decanted directly from the condensate.

After the solvent is released from the Silica Gel any adsorbed steam is driven off by passing clean heated air or gas through the Silica Gel beds. On completion of this operation the adsorber is cooled and is then again ready to be introduced into the

adsorber is cooled and is then again ready to be introduced into the adsorption cycle. In cases where high boiling hydrocarbons are present in the solvent the Silica Gel is occasionally given high temperature treatment which thoroughly cleans it, thus restoring it to its original efficiency.



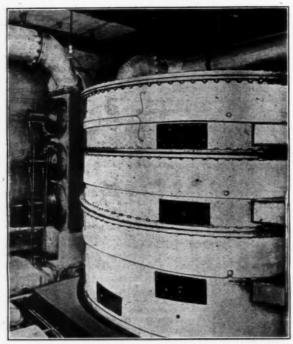
A TYPICAL SILICA GEL ADSORPTION PLANT.

Operating Costs and Recovery Effected

The Silica Gel process can be equally well appplied to solvent air mixtures of both high and low concentrations. The solvents to be adsorbed are always treated in dilutions which are well below the lower explosion limit, and as the solvent air mixture in the plant is under a slight suction no vapour can escape into the workrooms. The plants are of most

modern, compact design, with few moving parts, and the operation of larger plants is completely automatic, so that only a fraction of one man's time is required for servicing. The capital costs are relatively small, the saving effected even with low priced solvents allow of amortisation in very short time.

Operating costs embodying steam, electric power, heat, water and labour under normal conditions amount only to



SILICA GEL ADSORPTION PLANT: PART OF AN INDUSTRIAL INSTALLATION.

about 0.25d. to 0.35d. per pound of solvent recovered. To regenerate the Silica Gel hot air or gas at a temperature of about 400° F. is required; waste heat can be used, if available. The requirements in steam at atmospheric pressure for driving off the solvent varying between from one to three pounds steam per pound of solvent, according to the solvent. Requirements of electric power are confined to the operation of two or three small centrifugal blowers.

Using Silica Gel, the percentage recovery effected in the case of acetone and alcohol is 97 per cent.; for benzole it is 96 per cent.; ethyl acetate and alcohol, 94 per cent.; petrol, 98 per cent. These figures are based on data actually obtained in industrial installations, even at low concentrations of vapour in the air.

Coumarone Resins in Industry Some Advantages in Comparison with Natural Resins

ONE of the most important developments in recent years has been the introduction of synthetic products to replace the natural resins. Among these synthetic resins, those derived from coumarone occupy an important position owing to their extraordinarily wide range of application, and their unique chemical and physical properties.

The coumarone resins are obtained by the polymerisation of coumarone, which is a constituent of coal tar distillate. Being purely a polymerisation product it is quite inert chemically, but the successful manufacture of this type of resin depends upon careful scientific control at every stage of the process. This exactness in manufacturing technique is claimed to be a feature of the processes used by the Ostdeutsche Verkaufsvereinigung für Cumaronharz G.m.b.H., of Charlottenburg, Germany, for whom Brown and Forth, Ltd., 163, Euston Road, London, N.W.I., are the sole concessionaires for the British Empire. Their manufactures, known as

"Brofo" resins are perfectly neutral and therefore can be safely used in conjunction with any other substance without fear of chemical reaction. They are unaffected by water, dilute acids and alkalis, and are not saponifiable; can be used without frothing and decomposition, or appreciable loss in weight; and are soluble in coal tar solvents, turpentine, vegetable oils, and in all the usual solvents used in the paint and varnish industry, except alcohol.

Varnish Manufacture

Coumarone resins can be used with advantage both in spirit varnishes and oil varnishes. The spirit varnishes resemble those made with dammer, but the solution is perfectly stable, and being consistent in quality and free from insoluble impurities there is no waste due to filtration or sedimentation. The varnishes so made give rather brittle film, but this can be overcome by adding small amounts of plasticisers, of which castor oil, to the extent of 5 per cent., is one of the most effective. All the usual solvents can be used, but with some brands of white spirit the addition of up to 15 per cent. coal tar naphtha is necessary to give a satisfactory solution. Used for oil varnishes there is no loss on melting and the difficult and unpleasant operation of "gum running" is avoided. There is, therefore, a great economy in using these resins as regards time and money, for the natural resins lose from 15 to 25 per cent. of their weight in "running." Being absolutely inert, the acidity of the varnish is also much reduced, and its resistance to chemical action is greatly increased.

In paints and enamels, coumarone resins, by their inert

In paints and enamels, coumarone resins, by their inert character, eliminate all possibility of troubles due to "livering" and "setting up," which frequently occur in enamels containing basic pigments such as white lead and zinc white. They have only one limitation, namely, a tendency to give a slight yellowish cast to the film which prevents their use in white enamels and delicate blue tints. This yellowish tinge reaches its maximum intensity in about 48 hours, and after this there is no further change, and the extent of yellowing can be greatly reduced by careful manipulation in making the medium, especially avoiding overheating. This limitation only affects a comparatively small proportion of the enamels made on an industrial scale.

Cellulose Lacquers

Coumarone resins can be used with advantage in the lacquer industry, especially in conjunction with ester gums, for they are soluble in practically all the commercial solvents and diluents, and being free from impurity, require no filtration or treatment in order to give a perfectly clear solution. The durability and gloss of the lacquer film is also improved. The use of a plasticiser is necessary, and provided a suitable formula is used, the adhesive properties of the film are high.

In the rubber industry these resins are highly valued as an addition to rubber mixing. They act as a softener and, as rubber milling is an expensive operation, considerable economies can be effected by incorporating from 2 to 7 per cent. of coumarone resin. The hard grades are added in the form of a powder, but the soft grades are melted and poured into the compound and thoroughly worked in. The hard grades are usually employed for tyre compounds, rubber heels and such materials as require considerable mechanical strength; the soft grades are used in insulating tapes, friction compounds and similar materials. Here colour is not of great importance, as this is easily masked by pigments used.

Electrical Insulating Materials

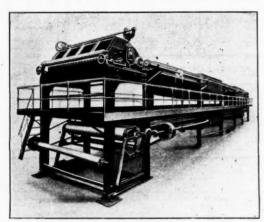
These "Brofo" coumarone resins are also very suitable for use in electrical insulating compositions on account of their neutrality, electrical resistivity, and water-proofing properties. An important property in this connection is that the electrical resistivity of materials containing such resins is less affected by the presence of moisture than is the electrical resistivity of rubber or mica.

They are used in linoleum manufacture, the high melting point and chemical inertness being of importance in this connection; in the form of emulsions they are suitable for use as a size for felt or paper; whilst fabrics impregnated with coumarone varnish are rendered highly water-proof and their durability is increased. Used as an ingredient of polishes and leather dressings they blend well with oils, fats, and waxes, and the polishes and dressings produced are of high quality; in this connection their high melting points and chemical inertness are, of course, also valuable qualities.

Solvent Recovery by Condensation Application in Manufacture of Leather Cloth

PLANT and equipment for the recovery of volatile solvents by the Boecler patent condensation system is constructed by Martini and Hüneke m.b.H., of Berlin, whose agent in the United Kingdom is Mr. J. L. Lake, of 58, Victoria Street, London, S.W.I. The accompanying illustration shows one of these plants as used in the manufacture of artificial leather, leather cloth and rubber-proofed textiles, where a high percentage of solvent evaporates during the spreading of the plastic mixture and must necessarily be recovered under economic conditions of working.

In many cases the actual horizontal spreading machines are 50 to 60 feet in length and several trough-shaped cooling com-



PATENT SPREADING MACHINE, WITH SOLVENT RECOVERY DEVICE, AS USED FOR MANUFACTURING AMERICAN CLOTH.

partments are incorporated, but in order to save space, to accelerate working speed and to avoid stretching the material to any great extent, they are often built in two storeys with a special patented device for returning the material when it has reached one end of the machine. Such machines, suitably modified, are used for the lacquering and drying of cloth and metal foil, and in the manufacture of balata belting. For fine and delicate fabrics, where the risk of stretching and shrinking is always present, spreading drums are used in place of horizontal spreading machines. Here the form of the drum facilitates the production of an evenly-spread cloth, whilst a saving in floorspace is another advantage. The construction of this unit is also advantageous for the recovery of the volatile solvent, as the vapours are forced into a minimum of space by the cylindrical shape of the hood, which gives good conditions for effecting a high-percentage recovery.

Emulsifiable Solvents for the Textile Trades

FOR a number of years Glover Bros. (Leeds), Ltd., of Wortley Low Mills, Leeds, has been manufacturing emulsifiable solvents under the name of "Texogent." These products have proved to be well capable of withstanding the competition, on both price and efficiency grounds, of the newer emulsifiable solvents which have been introduced.

For low temperature work they are particularly powerful in solvent action, and very mobile in character. Higher boiling solvents as used in boiling baths are also available for use, and these likewise are very efficient and economical in use. It is understood that Glover Bros. are contemplating the introduction of a new well-balanced soap-solvent combination which claims to have remarkable cleansing power, and which should be of particular interest to the laundry trade.

Solvents for Paint, Varnish and Lacquer Trades R. W. Greeff and Co., Ltd., specialise in solvents, and their wide experience obtained as a result of over 40 years' study of these products is at the disposal of their customers. Amongst the range of solvents handled by them are acetone, methyl alcohol, butyl alcohol and the esters, and a complete range of chlorine derivatives, including all solvents necessary for the paint, varnish and lacquer trades.

A Bookman's Column

In the lacquer industry the subject of solvents is one of importance not only from the standpoint of price but also from that of the quality of the lacquer produced. Particulars of solvents which are at present available for industrial use, such as may be found in the second edition of Solvents, by Thos H. Durrans (Chapman and Hall, Ltd., pp. 180, price 10s. 6d. net), will therefore serve a very useful purpose, more especially as a vast amount of information germane to this subject is scattered throughout the literature, very often in profuse manner lacking cohesion and clarity

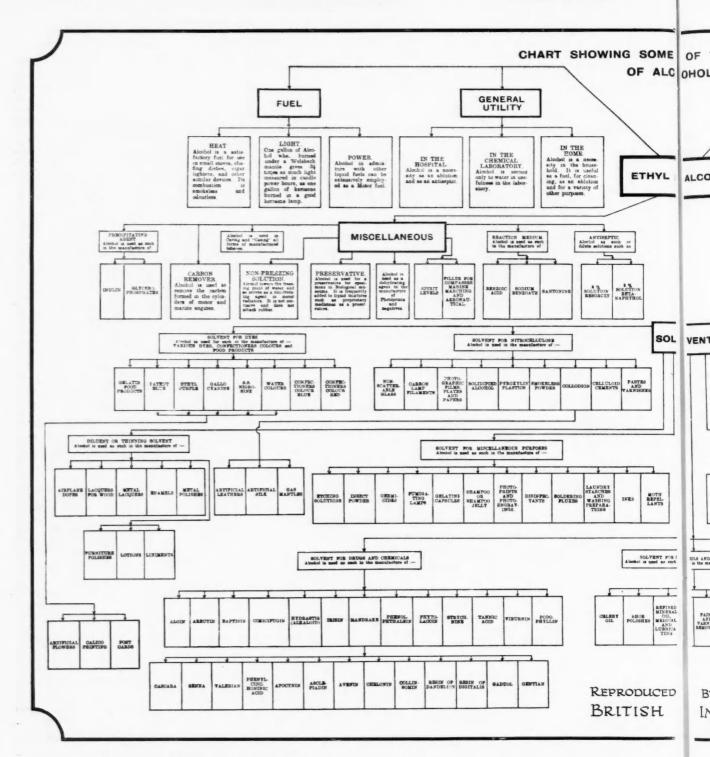
The first part of this book deals with the general properties of solvents, such as solvent action, effect on stability of cellulose films, viscosity, vapour pressure, inflammability and toxicity; the second part details the properties and manufacture of individual solvents, classified in well-defined groups. In comparison with the first edition which appeared in 1930, the chapters on plasticising solvents have been considerably extended, and a comprehensive table of solubilities and dictionary of trade names have been added as appendices. Details are also included of certain new solvents which have made their début during the brief interval which elapsed between the first and second editions, and more attention has been devoted to the many azeotropic mixtures which occur among the commonly used solvents.

Lectures delivered by Professor F. M. Jaeger, of the University of Groningen, under the George Fisher Baker Non-Resident Lectureship in Chemistry, at Cornell University 1928-29, have been published in book form (McGraw-Hill Publishing Co., Ltd., pp. 445, price 20s. net). This volume includes thirteen lectures concerning the spatial arrangement of atomic systems and optical activity, six lectures relating to problems of precise measurements at high temperature, and one on the constitution and structure of ultramarines.

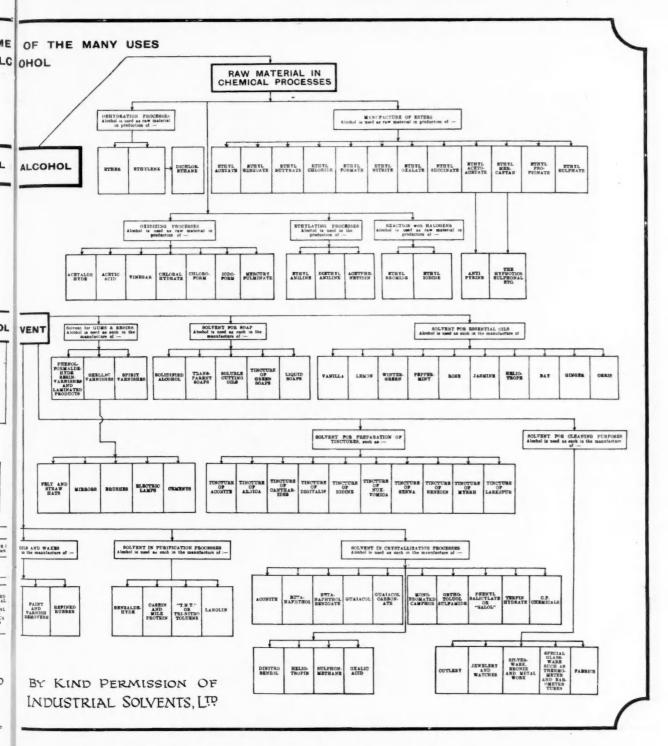
Dr. Ernest Fyleman, already known as the translator of several important scientific works from the German, has now similarly made available to English readers the well-known work by Dr. Johannes Scheiber and Dr. Kurt Sandig on Artificial Resins (Pitman and Sons, pp. 447, price 30s.). This presents a comprehensive account of the principles underlying the artificial resin industry and of their application in practice, which should be of interest to English-speaking readers. is interesting to observe," the translator remarks, "how the resinous, pitchy products which are the bugbear of the orthodox organic research chemist and which he is inclined to treat with chilly contempt, have become the basis of an important industry and are deliberately produced by tens of thousands of tons annually, being valuable by the very reason of the non-crystalline and chemically heterogeneous character which provokes the scorn of the contributor to Beilstein.'

IN volume II of a Handbook of Chemical Microscopy, by E. M. Chamot and C. W. Mason (Chapman and Hall, Ltd., pp. 411, price 22s. 6d. net) the authors follow up their discourse on the principles and use of microscopes, and physical methods for the study of chemical problems, with chemical methods as applied by the microscope for inorganic qualitative analysis. Photomicrographs of most of the common and useful tests have been included, but the user of this book is urged to carry out the various experiments given in order to see for himself not only the commonly prevailing types of crystals which have been selected for the illustrations, but also the variations from these normal appearances. Only by doing this, so we are informed by the authors in their preface, can the experience and judgment in interpretation and the manipulative skill, which is essential to intelligent and rapid analysis, be acquired.

Information and experimental data relating to electrolytic conduction lie widely scattered through volumes of the various acientific and technical journals, but the known facts have now been collected and presented in an ordered sequence in *Electrolytic Conduction*, by F. H. Newman (Chapman and Hall, Ltd., pp. 441, price 25s. net.) This book is written primarily for the physicist, but it will be welcomed by all who are interested in the conduction of electricity through solutions. It supplies the need, and gives not only a systematic survey, but also a full treatment of the modern theory of the complete ionisation of electrolytic solutions.

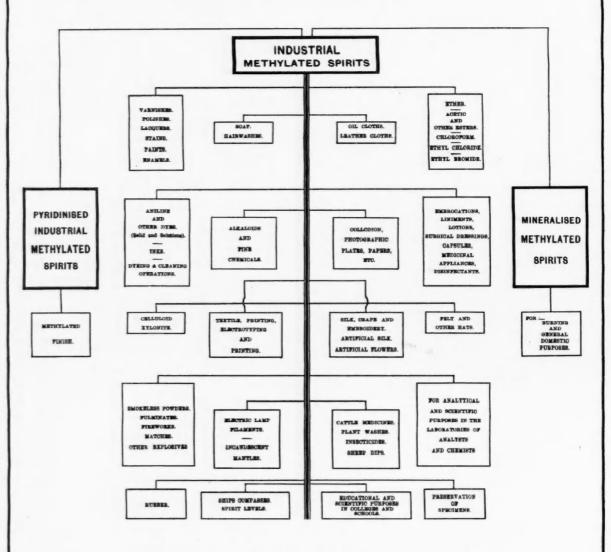


The above chart, which is reproduced by permission of British Industrial Solvents, Ltd., shows some of the many uses to which ethyl alcohol is applied in the industries, either as raw material involved in chemical manufacturing processes, as a useful solvent or diluent, or as a liquid of general utility for miscellaneous purposes. In its rôle as a solvent, it is extensively used in the preparation of solutions of gums and resins, nitrocellulose, soaps, oils and waxes, essential oils, drug extracts, and dyes for colouring food products; it is also usefully employed in purification processes, particularly in the crystallisation of certain organic chemical products. Used alone, ethyl alcohol is not generally regarded as a solvent for cellulose nitrate or acetate, but



the anhydrous liquid will dissolve some of the lower nitrated forms of cellulose. Its solvent properties in this connection rapidly decrease with increasing proportions of water, and when this reaches 5 per cent., the liquid is practically a non-solvent for all forms of cellulose nitrate. The anhydrous liquid will completely dissolve ethyl cellulose, colophony, sandarac, kauri, pontianac, manila, elemi, mastic, dammer, shellac, and gum camphor, and the addition of 20 to 30 per cent. of benzene renders it an efficient solvent for benzyl cellulose, ester gum and cumarone. It is also a solvent for certain synthetic resins such as the soft bakelites, acetaldehydeacrolein-, furfural-, cyclohexanone-, and the cyclohexanone-formaldehyde resins.

Diagram Showing Some of the Uses of METHYLATED SPIRITS.



Reproduced by Kind Permission of The Methylating Co., Ltd., London.

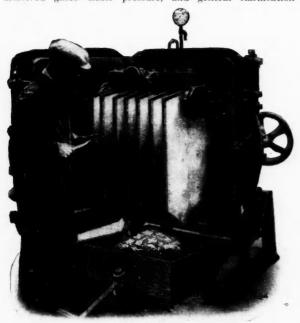
The Filtration of Recovered Solvents

New Filters with Novel Features

A NEW DESIGN in filters, especially suitable for dealing with solvents which have become contaminated by suspended solid impurities, has been introduced by Manlove, Alliott and Co., Ltd., of Bloomsgrove Works, Nottingham. In construction it consists of a number of leaves arranged in a chamber consisting of two halves or clams, having a single vertical joint. The material to be filtered is pumped into this chamber and cake builds up on the leaves while the liquid passes through internal drainage channels to the outlets at the top.

through internal drainage channels to the outlets at the top.

This "Easifilt" vertical leaf filter combines conditions favourable to high rates of filtration with facilities for rapid cleaning and discharge. It is adaptable and flexible in operation, occupies a relatively small amount of floor space, and the leaves may be covered with durable woven wire filtercloth. The cakes on adjacent leaves are not allowed to meet; they are readily washed; may be dried by vacuum, compressed air, or steam; and are easily discharged after drawing out the leaf battery or by sluicing. These features make it particularly suitable for handling solvents, liquids containing dissolved gases under pressure, and general clarification



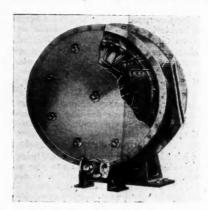
THE "EASIFILT" VERTICAL LEAF FILTER: CLEANING THE LEAVES.

problems. In addition, it presents advantages for a variety of other purposes, especially in cases where the solids build up a compact cake freely, or are such as permit adequate

de-watering by air drying.

High rates of filtration (60 to 70 gallons per hour per sq. ft. of filter area) are possible because of the ease with which the filter may be run on the most favourable cycle of operation, and may be discharged when the most favourable cake thickness has been reached, so that the period of greatly reduced flow during the consolidation of the cake is eliminated. Rapid filtration is also helped by the construction of the leaves. The filter cloth is supported on a coarse wire foundation having two drain channels, one communicating with the bottom and the other with the top of the leaf. These outlet channels are of large sectional area and provide an extremely free escape for the filtered liquor. They are separately controlled so that the bottom outlet may be used alone when the cake is finally dried out, and this disposes of any liquid which might otherwise be trapped in the drainage screen, making the cake wet. Sedimentation is minimised by the good agitation provided for by the arrangement of feed passages and distributing plate which causes the incoming liquid to sweep over the whole sloping bottom of the filter, producing a circulation which is of considerable assistance in building up an even cake.

The "Wolfe Keene" multi-leaf auto-filter, which is made by Wolfe Keene and Co., of 15, Chapel Lane, Hull, is another filter particularly adaptable for the final clarification of solvents, lacquers, oils, varnishes, and liquids of a syrupy consistency. One of these filters is also illustrated, being cut to show the internal arrangement of leaves and washing-down



THE "WOLFE KEENE" MULTI-LEAF AUTO FILTER.

device. The leaves are rectangular in shape, and are mounted upon two co-axial and spaced hoops, at an angle to the axis of rotation of the hoops with one side of each leaf always in advance of the edge of the opposite side. (A better idea of this angle of inclination can be gathered by observing the position taken up by the door on the peripheral wall of the filter casing.) By this arrangement of the leaves the extraneous matter for discharge has an uninterrupted fall, thus ensuring a complete cleansing of the filter prior to recharging. The actual filter illustrated has a total filtering area of 125 sq. ft. The individual filter leaves are easily and quickly detached for attention or replacement, and the filtrate-bleeds are separate, each being fitted with a sight glass and control.

Solvents and Plasticisers

Increasing Consumption Necessitates More Research

During 1930 it was pointed out that for the past quarter of a century the demand for organic solvents had continuously increased. New outlets have been found and new uses thus created act as a stimulant to the manufacturers of these materials. It is, therefore, not only the consumer who has to study the relative advantages of different solvents for a particular purpose, but also the manufacturer, who aims at producing a product which will fulfil the needs of the consumer. Such problems are being examined daily by J. M. Steel and Co., Ltd., of 36, Kingsway, London, W.C.2., who have at their disposal, through their relationship with several Continental houses, a large organisation for technical research.

Apart from the better known solvents for the lacquer industry, they can offer a number of products which have certain advantages for specified purposes, among which are Dioxan, methyl acetate, glycol mono acetate and ethyl acetyl glycollate. For the extraction of grease and fat, methylene chloride is a good solvent which has the advantage of being non-inflammable. With the introduction of the cellulose ethers, products which had been regarded in the lacquer industry as diluents, such as benzol and toluol, have now become important solvents for these cellulose derivatives which are entirely soluble in aromatic hydrocarbons with or without an addition of industrial spirit, depending on the grade of cellulose ether used.

Increased Use of Casein in Switzerland

Swiss casein imports increased in the first quarter of 1931 to 245 metric tons, compared with 25 tons in the corresponding period of the preceding year. Of this quantity France supplied 198 tons and Argentina 47 tons. Total imports in 1930 amounted to 203 tons.

Solvents for Cellulose Lacquers Their Future Prospects

THERE was a time when a new product aroused the greatest opposition, especially if it was intended for an industry whose foundations were laid in a less progressive and less scientific age. To-day, however, the reverse is the case, and most industries, among them the modern lacquer industry, are on the alert for new products. Here, there appears to have been quite a revolutionary change of attitude, and conservatism has given place to "progressivism." This somewhat convulsive change is undoubtedly due to the scientists and scientific methods of production. This impetus has been irresistible and responsible for the remarkable progress in the chemical trade and any industry where the chemist has laboured.

In the case of solvents and other products for the lacquer industry, many such products are often insufficiently tested before they are offered to the trade, owing to the anxiety of the manufacturers to effect sales.

In consequence the lacquer chemist has to do much work which should have been done for him, or risk being left behind in technical production. Sometimes, too, the new product is not available in sufficiently large quantities to meet a demand which could quite easily have been estimated. The trouble is often accentuated when the product is of foreign origin, delay in transport causing inconvenience. There have been instances, in fact, of products being withdrawn altogether by foreign manufacturers, or their agents, after users have standardised on them. The reasons for such withdrawal were dissatisfaction of the quality, and the unwillingness, by the manufacturers, to risk their reputation, because they felt further research work upon the products was necessary.

The time has therefore probably come to question the craze for novelty, and ask whether it would not be more useful to study the main lines of advance in scientific lacquer production, and to concentrate upon their improvements, rather than taking up several different lines, which are as yet still in the "research" stage. In the case of solvents for lacquer manufacture, it would appear desirable to examine the still greater potentialities of those solvents and their derivatives, which have already proved themselves of inestimable value to the industry. Among these are included the amyl and butyl compounds, the present high standard of which in England are in no small measure due to the researches during many years of Dr. Edgar Neumann and his staff of The Chemical Supply Co., at Barking. Apart from extensive work on new processes, and development of additional products, Dr. Neumann is also engaged, at present, in researches upon the future possibilities of the accepted standard solvents, with a view to production on still more economic lines.

"Acticarbone"

An Activated Carbon for Solvent Recovery

Large quantities of volatile solvents are now used in manufacturing processes and in many cases these are evaporated to a great extent and so wasted, as in the india-rubber, water-proofing, dry cleaning, leather cloth and rayon trades. These solvents can, however, be recovered with a degree of efficiency and at low working costs by the use of the activated carbon which is referred to under the trade mark of "Acticarbone." This material is made by a patented process and is supplied in various grades to suit different purposes such as the adsorption of gases or vapours, the drying of air or gases, decolourisation, etc. It is especially efficient when the vapours of solvents in air are at low concentration, but the efficient application of the recovery process also depends upon the skilful application of the principles and limiting factors involved.

The Société de Recherches et d'Exploitations Pétrolifères, of Paris, the makers of Acticarbone, have studied the recovery of volatile solvents in great detail and have a wide practical experience of recovery problems. In order to investigate new problems which are constantly arising, they maintain well-equipped laboratories in Paris. Upwards of 70 plants are now in operation or construction on the Acticarbone process so that its efficiency and the economy effected is well established. The representatives for Great Britain and the Colonies are Price, Stutfield and Co., Ltd., 6, Fenchurch Buildings, London, E.C.3, by whom technical literature will be sent to those interested.

In the recovery of volatile solvents by the use of Acticarbone' the mixture of air and solvent vapour is passed through a mass of this material contained in an absorber. Here the carbon absorbs the solvent vapour and when saturation is reached the solvent is distilled off by means of steam. By suitable attention to the factors involved, especially to the grade of Acticarbone used and methods applied for heating and cooling, very high recovery efficiencies can be obtained, and the condensed solvent is clean and pure. In obtaining high factory efficiencies it is also important to collect the solvent vapours without hindering the practical operations of the works; in this connection a very detailed study of the best methods to adopt has been made by the Société de Recherches et d'Exploitations Pétrolifères, so that there is a maximum delivery of vapour to the recovery plant. The fact that very low concentrations of solvent in air can be successfully treated also helps this collection considerably, besides contributing largely to the whole safety of the factory where inflammable solvents are used.

Although this collection problem is more or less standardised for certain types of machines and processes, a detailed study is always advisable and will be willingly undertaken by Mr. S. Reginald Price, of Price, Stutfield and Co., Ltd. In practice, overall efficiencies of 70 to 90 per cent. can be obtained, according to the nature of the problem. A strict guarantee of practical yield is given for each plant installed, and the economy possible by saving, say, 80 per cent. of the solvent bought each year is at once obvious. Operating costs for the process are very low and the loss of carbon is almost negligible

Chemical Matters in Parliament

Sulphate of Ammonia (Export)

In the House of Commons on Friday, June 19, Viscount Lymington asked the President of the Board of Trade (1) To what countries and at what average price sulphate of ammonia has been exported in the past 12 months? (2) If sulphate of ammonia has been exported on credit to Soviet Russia during the last 12 months: and if so at what price?

the last 12 months; and, if so, at what price?

Mr. W. R. Smith: The following statement shows the total quantity of the domestic exports of sulphate of ammonia from the United Kingdom registered during the 12 months ended May 31, 1931, distinguishing the principal countries to which consigned; these figures are provisional.

Countries to which consigne	ed		Quantity Tons.	Declared Value.	de	cla	age red er ton.
to mileti consigni	-		201101	f	£	S.	d.
Spain and Canaries			159,453	1,140,242	7	3	0
China (including Hong	Kong)		78,298	600,477	7	13	4
Soviet Union (Russia)			75,898	532,273	7	0	3
Japan			53.759	381,381	7	I	II
Dutch East Indies			19,091	145,916	7	12	10
Irish Free State			18,677	143,468	7	13	8
Portugal			18,507	129,454	6	19	9
British India			15,456	109,709	7	2	0
Australia			10,459	75,183	7	3	9
British West Indian Is	lands a	nd					-
British Guiana			9,504	68,931	7	5	I
Ceylon and Dependenc	ies		6,290	44,028	7	0	0
All other countries			31,628	235,301	7	8	10
Totals and average va	alue		497,020	3,606,363	7	5	I

I am not in a position to make any statement as to the terms upon which this commodity has been exported to the Soviet Union, except that the average price has been as shown above.

Huntington, Heberlein and Co., Ltd.

THE BRITISH METAL CORPORATION group has recently acquired control of Huntington, Heberlein and Co., Ltd., Equitable House, King William Street, London, E.C.4, who specialise in mechanical roasting furnaces, Dwight-Lloyd sintering machines, coal washing plants, drying and screening plants, sulphuric and hydrochloric acid plant, and general engineering equipment for chemical and metallurgical works. Since their establishment in 1908, they have gained considerable experience in roasting, sintering and washing problems. It is felt, however, that the company's operations will now be materially assisted by its association with the British Metal Corporation group.

From Week to Week

The first meeting of creditors of the British Cement Products and Finance Co., Ltd., will be held at Holborn Restaurant, London, W.C., on July 1, at 11 a.m.

The World Conference on the limitation of the manufacture of narcotic drugs, sitting in Geneva, on Saturday last, June 20, adopted the Franco-Japanese proposals as a basis of discussion.

AN EXPLOSION has occurred at the Lonza Chemical Works at Viège, Canton Valais, Switzerland, on Friday, June 19, causing an emission of poison gas, which endangered the lives of workers. G. Zurbriggen, one of the chemists, forced his way into the building and stopped the leakage, but was severely gassed, and died later.

The Tasmanian Minister for Mines (Mr. Claude James) has devoted some attention recently to the question of the osmiridium market, with a view to ascertaining whether some form of control could be established with the object of stabilising the London market. Mr. James has discussed the matter at different times with the Commonwealth authorities, who are prepared to set up a marketing board, provided the diggers are in favour of such a step.

SIR FREDERICK GOWLAND HOPKINS, the distinguished scientist, was honoured with the degree of Doctor of Laws at Glasgow University on Wednesday, June 17. Sir Frederick has devoted his life to the cause of chemical science, and his work on vitamins and the oxidative changes in living matter did much to put this field of investigation on a sound basis. He received the Nobel Prize for medicine in 1929, and is president of the Royal Society.

At a recent meeting of the Gas Committee of the Belfast Corporation the manager announced that the ChemicalWorks Section had completed a series of successful experiments on the production of a coal tar oil substitute for petrol, for use in internal-combustion engines. Tests had been carried out with the fuel on omnibuses of one of the Belfast companies, and these had proved satisfactory. The Belfast Gas Works intend to produce this fuel in quantities of approximately half-a-million gallons annually, at a cost well below the present price of petroleum spirit.

According to returns given in the Ministry of Labour Gazette for June, 16,484 persons were registered as wholly unemployed on May 18, in respect of the chemical industry in Great Britain and Northern Ireland; an additional 2,030 persons were affected by temporary stoppages. These figures do not include persons engaged in the manufacture of explosives (wholly unemployed, 2,262, temporary stoppages 513); paint, varnish, red and white leads (wholly unemployed, 1,847, temporary stoppages 134); and oil, glue, soap, ink and matches (wholly unemployed, 7,475, temporary stoppages, 1003)

INCREASED ACTIVITIES are reported from the works of Synthetic Ammonia and Nitrates, Ltd., at Billingham. After having been employed on short time for two months, 200 men are to recommence full-time employment. Manufacture of phosphates for concentrated fertilisers will cease for some time, but the manufacture of ammonia sulphate will be considerably increased in order to supply foreign markets, and it is this change which is responsible for the increased employment. More contracts for the supply of cement have also been obtained, and this department will be engaged upon their present maximum output for the rest of the year.

After entertaining the members of the Castleford Fire Brigade at dinner on Thursday, June 18, in recognition of the gallantry they displayed at the chemical works explosion on July 4 last, the Castleford Urban Council, through their chairman, Mr. T. J. Brooks, publicly presented a bronze medal to each fireman. Among the guests at the dinner were Sergeant Stevenson and Constable Faulkner, of the Leeds City Fire Brigade, whose gallantry in the explosion was commended by the Home Office; Police-Inspector Gee (awarded the British Empire Medal by the King); Captain G. D. Horsman, of the Castleford Fire Brigade (awarded the Police Medal); Mr. T. P. Carr, manager of the Yorkshire Coking and Chemical Co., and Mr. J. Lawrenson, one of the chemists at Hickson and Partners' Works, whose bravery after the explosion was also commended.

ON WEDNESDAY EVENING, June 24, Dr. W. H. Hatfield broadcast an address on "The War Against Rust," one of the series of talks on chemistry in industry.

THE INTERNATIONAL SUGAR COUNCIL held its first meeting at the Savoy Hotel on Monday and Tuesday, June 22–23, with Senator Beauduin, of the Belgian delegation, in the chair. There was a full representation of the Cuban, Javan, Czechoslovak, German, Polish, Hungarian and Belgian associations. The Council confirmed the permanent organisation of its headquarters at The Hague. The next meeting will be held in Paris on September 14.

At the general meeting of Vereinigte Glanzstoff-Fabriken A.-G., the artificial silk company at Elberfeld, held in Berlin, on Tuesday last, June 23, the chairman, Dr. Bluethgen, declared that the result of the merger with Enka had satisfied all expectations. He added that the corporation had no bank creditors, and in view of the low prices, and despite rationalisation, there was hope that the company would show a satisfactory profit for 1931.

The Standard Oil Co. of New York and the Vacuum Oil Co. are named as defendants in suits in the Supreme Court, New York, demanding \$105,000,000 in connection with the alleged purchase of 35,000,000 barrels of oil from the Soviet since January, 1925. The plaintiffs are Salimoff and Co. and twenty-five other Russian oil companies, whose concessions have been confiscated by the Soviet. The plaintiffs allege that the American firms bought the oil knowing it to have been "wrongfully" seized by the Soviet.

Recent wills include Colonel James Ogston, of Aberdeen, head of Ogston and Tennant, Ltd., soap manufacturers, Aberdeen and Glasgow, personal estate in Great Britain £247,978; Mr. Ernest Frederick Hilton, of Croydon, a director of Hilton, Anderson and Co., cement manufacturers, and afterwards connected with the Associated Portland Cement Manufacturers, £50,246 (net personalty £49,443); Mr. George Frederick Reckitt, of Sneyd Park, Bristol, of Reckitt and Sons, Ltd., starch, blue and metal polish manufacturers, £577,082 (net personalty £575,426).

At the Lancashire Chancery Court at Liverpool, on Monday, June 15, the Highfield Tanning Co., Ltd., of Runcorn, were successful in their application for sanction to a reduction of the company's capital. It was said the company had been extraordinarily successful, and for the last ten years had paid dividends of between 12 and 20 per cent., but its capital was now in excess of its requirements, due to the fall in cost of production for leather. The reduction suggested was from £500,000 to £351,000, and it was proposed to repay to the preference shareholders £28,500 and to the ordinary shareholders £102,000.

According to a report received from Frankfort, negotiations between the I.G. Farbenindustrie (German Dye Trust) and the Montecatini S.A., of Milan, with regard to taking over of the Acna Chemical Co., are now so far advanced that the formation of a new Acna company has been decided upon with a share capital of 60,000,000 lire, of which Montecatini will hold 31,000,000 lire and the German Dye Trust 29,000,000 lire. This new concern will take over the existing Acna factories at Rho, Cesano, Maderno and Cengio, but that section of the old Acna company which was occupied with the manufacture of explosives is to be incorporated into a separate company with a capital of 10,000,000 lire, which will be exclusively in the possession and under the control of the Montecatini S.A., and will carry on its business in the former Acna company's factory at Bussi.

Obituary

Mr. Thomas Simpson, chairman of Wilkinson and Simpson, Ltd., manufacturing chemists, Newcastle, aged 87.

Frank Wigglesworth Clarke, past president of the American Chemical Society, and for forty years chief chemist of the U.S. Geological Survey, died May 23, at his home in Chevy

Chase, Md., at the age of 84.

The death of Mr. W. H. Butler, head of the firm of William Butler and Co., chemical manufacturers, Bristol, has created widespread regret in the West of England. Mr. Butler, whose death occurred at the Priory, Westbury-on-Trym, was in his 81st year. He had a long record of public service, and from 1892 to 1897 had a seat on the Gloucestershire County Council. In 1893 he was made a Justice of the Peace for the county.

The Future of the London Boy

A Brilliant Gathering at the John Benn Hostel Banquet

THE gathering of the fourth annual banquet of the East End Hostels Association at the Stationers' Hall, London, on Tuesday evening, June 23, was one of the most brilliant of the series. Mr. Gordon Selfridge presided, and the guests included distinguished representatives of Parliamentary, literary, commercial, and social interests.

The Prince's Message

The Chairman, in submitting the loyal toasts, made special reference to the personal and sustained interest that the Prince of Wales had taken in the Hostel since he opened it some few years ago, and read the following message from the Prince in reply to one of congratulation on his birthday: My sincere thanks to you, to the boys of the John Benn Hostel, and the members of the East End Hostels Association for your birthday greetings, which I much appreciate. I send my best wishes to all present at the fourth annual banquet for an enjoyable evening."

The Chairman, speaking as a business man, described the Prince of Wales as the Prince of Salesmen. He sold good cheer. Wherever he went he sold the spirit of good feeling throughout the British Empire. He was the perfect example of the true gentleman, and his friendship for, and personal interest in, the Hostel was one of its very greatest assets. Whatever he did, wherever he went, he was working for the betterment, the progress, and the prosperity of the great country he represented. (Cheers.)

The London Boy

Lt.-Col. John Buchan, M.P., in proposing the toast of the "London Boy," described him as a national possession, since he represented the normal human child, with certain idiosyncrasies due to his special environment. He might be an imp of Satan, but he was infinitely resourceful, never lacked spirit, and had the priceless gift of humour. The London boy represented splendid raw material, and centres of instruction and amusement for growing boys, such as the John Benn Hostel, helped them to enjoy their leisure, increased their aptitude for work, and encouraged them to proceed to true education. There were only two ways of building up manhood. One was by imagination and sympathy. The old-fashioned charity was often only a form of condescension, the rich man eased his conscience by patronising the poor man, and the burglar's call was a proper return visit from the poor man to the rich. (Laughter.) "You cannot," he said, "help a man or a boy unless you really sympathise with him. He will accept help not from a patron but only from a friend." Secondly, nothing could be done without intelligence—knowledge as against casual good nature, discipline and self-respect as against hothouse sentimentality Bernard Shaw's reference to the hard-hearted kind and the soft-hearted cruel had deep philosophy in it; the finest emotion was useless without brains behind it. The Hostel motto, "No pains, no gains," deserved to become a national maxim. The work done by the Hostel was a fine piece, not only of practical Christianity but of practical statesmanship, laying broad and deep foundations for the wider common-wealth of the future. (Cheers.)

The Earl of Feversham, the Chairman of the Council of the East End Hostels Association, in responding, said it was the purpose of the Hostel to give homeless and parentless boys a real chance in life. "We can do," he said, "no better work than looking after the youth of the country at its most important and influential age

The Work of the Hostel

The toast of the John Benn Hostel was proposed by the Head Master of Westminster School (Dr. H. Costley-White). Answering the questions "What is it?" and "What does it do?", he described in detail a late evening visit he paid to the Hostel, and bore convincing testimony to the excellence of the work that was being done for the 70 to 80 boys of from 14 to 18 years who lived there. He emphasised especially the importance of home life to young people, and said that the Hostel was supplying the boys with that which misfortune had denied them, and was striving to turn homeless, fatherless

potential wastrels into fine citizens. (Cheers.)

The Rt. Hon. Wedgwood Benn, M.P., acknowledging some warm tributes to the memory of his father, described the Hostel as a memorial to a London boy who loved London and strove his hardest to serve the city that he loved so well Something must be done to assist young boys who were homeless, for the sake not only of the boys themselves but of society and the nation. His Individualist brother, he imagined, might sympathise with the idea of universal and compulsory good citizenship. This teaching of good citizenship, which the Hostel had in view, came not so much from injunction as from example, and it was impossible to speak too highly of the spirit in which the boys were handled in the Hostel. Such work must be done with sympathy and humility, on terms of equality, not on terms of condescension. So, through such institutions and influences, they might hope to produce a race of London boys who might be given a fair chance and might make the fullest use of what they had been privileged to enjoy

The Milner Hall

The toast of the sister institution, the Milner Hall, was proposed by Lord Burnham, who stated that the Archbishop of Canterbury said the other day that there was need of greater joy and cheerfulness in the service of the Church, but it was still more incontestable that there was room for a great deal of joy and cheerfulness in the home life of East London. In such matters the John Benn Hostel, and especially the Milner Hall, situated in a poverty-stricken neighbourhood, played a prominent part.

The Mayor of Stepney (Councillor M. H. Davis), in responding, testified to the good work the John Benn Hostel was doing in the borough. Life, he said, in the East End of London, had been uplifted as the result of the Hostel, and what was being done in Stepney could be done by such institutions throughout the country.

Sir Ernest Benn, the president of the Association, proposed the Livery Companies, and referred to the great part they had played in London history and to their important work to-day. Speaking of the Hostel, he said that his part was simply to voice the obvious need of funds for carrying on the work. had never worried very much about money, believing that if the goods were right, if they delivered the goods, if they really did the job, than the finances would follow. He left it to them to do what they felt they could do in support of a very much needed work in the East End.

The Master of the Stationers' Company (Mr. E. E. Harrison) briefly responded.

The last toast was that of the Chairman, proposed by Sir Edward Iliffe. Mr. Gordon Selfridge, in reply, described the work in which they were engaged as one of the most beautiful and practical he had ever been engaged in; so much was he impressed, that he felt impelled to try to duplicate it.

It was announced later that in response to Sir Ernest Benn's appeal the sum of £1,250 had been contributed. It was also stated that the Queen had definitely promised to attend a Ruth Draper matinee in aid of the Hostel at the Vaudeville Theatre on Friday, June 26.

New Physics Building at National Physical Laboratory

THE National Physical Laboratory, at Teddington, was open to visitors on Tuesday last, June 23, this annual function being preceded by the formal opening of the new physics building by Sir Gowland Hopkins, president of the Royal Society, and chairman of the General Board of the Laboratory. Speeches appropriate to the occasion were made by Sir Richard Glazebrook, chairman of the Executive Committee, and by Sir Joseph Thomson. In the course of his speech, Sir Joseph Thomson congratulated Sir Richard Glazebrook on this further step in the phenomenal development of the N.P.L., which owed its prosperity to Sir Richard Glazebrook's wisdom, energy and insight as much as to anything else.

Chemical Industry Lawn Tennis Tournament

Second Round Results and Third Round Draw

As the Tournament proceeds the interest in the matches grows steadily. Some excellent play has been witnessed in the first and second rounds, and as the stronger couples are brought into contact the competition should be particularly keen.

The results of the draw for the Third Round are announced in this issue. Competitors should note that all games in this round must be played off by July 14, and the results, signed by the winners and the losers, forwarded to The Chemical Age, Bouverie House, 154, Fleet Street, London, not later than Wednesday, July 15. As in the previous rounds, players must make their own arrangements for playing off their matches on a ground mutually agreed upon. In the event of disagreement the first name drawn shall have the right to choose the ground. An illustration of the Challenge Cup to be presented to the winners of the Tournament by Benn Brothers, Ltd. (the proprietors of THE CHEMICAL AGE), appeared in The Chemical Age of May 9.

SECOND ROUND RESULTS

H. Anning and T. Baxter won 6-o, 6-o against S. J.

Adams and A. E. Carter.
S. Newman and E. J. Lawrence won 6—0, 6—1 against W. S. Vorley and G. K. Skidmore.

G. Stanford and J. Shirreff won 7—5, 2—6, 8—6 against H. Nowell and K. L. Fuller.

J. W. Urban and F. S. Mortimer won 4—6, 6—1, 6—4 against G. T. Gurr and M. W. Papillon.
S. B. Gane and D. E. Raine won 6—4, 6—2 against L. Anderson and F. Wildman.
S. Perridge and W. L. Alldis won 6—2, 6—1 against G. C. Backinsell and R. A. Nottingham.

W. Speakman and S. E. Chaloner won 6-0, 9-7 against

N. J. Price and J. Ferguson-Davie. W. Tracey and D. G. Blow w.o. (J. Marquick and F. Brown).

THIRD ROUND DRAW

G. Stanford and

J. Shirreff (Johnson Matthey and Co., Ltd., Hatton Garden, 'Phone: Holborn 6989). London.

H. Anning and

T. Baxter (British Industrial Solvents, Ltd., London. Phone: Clerkenwell 2364).

W. Speakman and

S. E. Chaloner (Graesser-Monsanto Chemical Works, Ltd., Ruabon. ('Phone: Ruabon 3).

S. Newman and

E. J. Lawrence ("The Industrial Chemist," 33, Tothill Street, London, S.W.I. 'Phone: Victoria 8836).

S. B. Gane and

D. E. Raine (Johnson Matthey and Co., Ltd., 71/73, Victoria Street, Birmingham. 'Phone: Birmingham Central 6726/).

J. W. Urban and

F. S. Mortimer (Graesser-Monsanto Chemical Works, Ltd., Victoria Station House, Victoria Street, London, S.W.I. 'Phone: Victoria 1535).

S. Perridge and

W. L. Alldis (Chemicals and Coke Ovens, Vintry House, Queen Street Place, London, E.C.4. 'Phone: Central 1411).

W. Tracey and

D. G. Blow (The British Drug Houses, Ltd., Graham Street, City Road, N.1. 'Phone: Clerkenwell 3000).

The N.C. Metal Co. Mr. H. M. Ridge Appointed Managing Director

THE ordinary general meeting of the N.C. Metal Co. was held on Wednesday at Winchester House, London, Mr. L. Wiese

(the chairman) presided.

The Chairman, in moving the adoption of the report and accounts, said: Since the date of the balance sheet at December 31, 1929, the capital of your company has remained unchanged. Satisfactory progress has been made in developing the Coley process, but negotiations have been severely hampered by the continual downward movement of prices in In 1913 the average price for spelter was £22 10s. Last December it dropped to £13 5s., which was the lowest figure since 1885. Since then it has further fallen to £9 13s. 9d. on the 4th of this month, which is a record. In these circumstances it is not surprising that the negotiations initiated by us in various parts of the world have not matured. The period of the option which we granted in Canada has been extended for the same reason. The lower metal market prices have not stimulated consumption. On the contrary, the demand for all the non-ferrous metals has contracted materially. you one instance, the export from this country of galvanized sheets, which in 1913 amounted to 63,500 tons a month, averaged about 21,000 tons during the first five months of this

Mr. Ridge's Appointment

We are, however, confident that when the economic position improves our process will come into its own, and, in order to be prepared for this, we have recently elected on to our board and appointed as managing director Mr. H. M. Ridge, who has been connected with the zinc industry for over 30 years. Mr. Ridge has had experience not only in the mining and treatment of ores but also in the production of various metals. He has acted as consulting engineer in the erection of zinc and other metal smelting works, both at home and abroad, and is well acquainted with the various processes in use. He was instrumental in introducing the first successful methods for utilising the zinc content of the Broken Hill sulphide ore in

Australia. Before agreeing to join our board, Mr. Ridge satisfied himself of the technical value of our process, and I will later ask him to say a few words.

When I addressed you last year I told you about our subsidiary, the Metallic Ore Reduction Co., which was formed to try out the application of the Coley process to the treatment of tin ores. The work carried out on the experimental plant in Cornwall has given promising indications, and further steps are being considered by your directors.

Mr. H. M. Ridge, M.E. (managing director), seconded the resolution, which, after the Chairman had replied to questions, was carried with two dissentients. The retiring directors

were re-elected.

British Netherlands Artificial Silk Co.

NOTICE of a petition for the winding up of the British-Netherlands Artificial Silk Co., Ltd., appeared in the London Gazette, on Friday, June 19. The petition will be heard on June 29. Registered in 1928, this company has an authorised and issued capital of £855,000. The last balance-sheet showed that of total assets of £512,523, patents, etc., represented £32,500, plant and machinery £293,087, preliminary expenses £51,167, underwriting commission £18,950, and the debit at profit and loss £23,900. Capital (less calls in arrear) appeared at £419,905 owing to the fact that 760,507 Ios. Ordinary and 124,320 Is. Deferred shares have been forfeited.

Nitrocellulose Lacquers in Portugal

NITROCELLULOSE lacquers are not at present manufactured in Portugal, and the total requirements of the market are It is reported, however, that the Sisitana de Fintas e Vernices (Ltd.), intends to extend its Lisbon factory and produce nitrocellulose lacquers, which are now supplied principally by the United Kingdom and the United States. In Portugal there is a fairly large demand for nitrocellulose lacquers and, although there is no local manufacture of motor cars, outlets are found among the automobile body builders, garages and repair shops, of which there are a large number

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Accepted Specifications

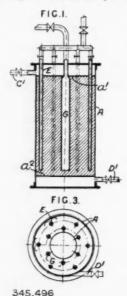
345,391. OXYGENATED ORGANIC COMPOUNDS. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, January 16, 1930. Addition to 312,388. (See The Chemical Age, vol XX, p. 620.)

Specification 312,388 describes a process in which air, oxygen or nitrogen oxides are passed at 80° to 200° C. under pressure or not, through liquid benzine hydrocarbons boiling below 180° C. to obtain oxygenated compounds. Catalysts such as resinates or oleates of alkali or alkaline earth metals, magnesium, aluminium or manganese may be used. In this invention, the reaction is influenced to produce mainly alcohols or their esters by adding at least 2 per cent. of a saturated aliphatic carboxylic acid containing not more than four carbon atoms. In an example a mixture of hexane with 10 per cent. of acetic acid, containing manganese acetyl acetonate is treated with air at 145° C. and 20 atmospheres pressure, in an aluminium-lined tube with filling materials. The product consists mainly of esters of acetic acid with lower alcohols, which are separated by distillation. Other examples are given of the treatment of petroleum fractions.

345,451. DIAMMONIUM PHOSPHATE. Soc. d'Etudes Scientifiques et d'Entreprises Industrielles, Ougrée, Belgium. Assignees of E. Voituron, 260, Rue Ernest Solvay, Sclessin, Ougrée, Belgium. International Convention date, February 26, 1929.

Phosphoric acid is neutralised with ammonia in two stages, in the first of which more than one molecule of ammonia per molecule of acid is absorbed by the boiling acid, and the remainder of the ammonia, about $\frac{1}{4}$ to $\frac{1}{3}$ of the whole amount necessary to cause separation of the salt, is absorbed in a second saturator at 60° to 70° C. The solution is agitated by blowing in air, and the air and steam are used to preheat the liquor.

345,496 and 345,511. CATALYTIC APPARATUS. Compagnie Internationale pour la Fabrication des Essences et Pétroles, 18, Rue Keppler, Paris. International Convention date, August 2, 1929, and January 13, 1930.



345,496. In the treatment of gases and vapours obtained from carbonaceous materials such as lignites, shales, heavy oils, etc., a catalyst is contained in a chamber A between two grids a^1 and a^2 and the gas passes through the catalyst

from $C \mathbf{1}$ to D^1 . The catalyst is regenerated by air, with or without steam, which is distributed through the catalyst by a series of vertical pipes E having perforations directed towards the wall of the chamber A. The gas is withdrawn through a central outlet or series of outlets or pipes G.

345,511. This is an addition to 345,496 above, and consists in the use of a coil of piping in the catalyst between the inlet and outlet pipes for circulating heating agent during the catalytic process, and a cooling agent during the regeneration process.

345.494. Ammonium Carbamate. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, March 24, 1930.

Ammonia and carbon dioxide react in an aqueous solution of urea at 5° to 50° C., the solution being stirred, or preferably brought into a fine state of dispersion. Ammonium carbamate is obtained and separated from the solution.

345,518. Magnesium Chloride. E. Lacell, Enderly, Lansdowne Road, Finchley, London. International Convention date, April 5, 1929.

Hydrated magnesium chloride is added to a large mass of liquid anhydrous magnesium chloride containing potassium chloride to lower its melting point. The mixture is heated to 500° C. by alternating current or high frequency induction current, and the pressure is reduced to facilitate evolution of steam. Anhydrous magnesium chloride is obtained.

345,556-7. Manufacture of Sulphur Trioxide. Calco Chemical Co., Inc., Boundbrook, N.J., U.S.A., Assignees of A. P. Beardsley, Plainfield, N.J., U.S.A., and N. A. Laury, Rockville Centre, N.Y., U.S.A. International Convention date, May 13, 1929.

345.556. A catalyst for the oxidation of sulphur dioxide consists of a mixture of a vanadium compound with up to three times the atomic proportion of a rubidium compound. In an example, a carrier consisting of celite chips calcined at 100° C. is saturated with ammonium metavanadate solution and dried at 100° C. The material is then sprinkled with rubidium chloride solution and dried at 110° C., and then heated to 500° C. in an atmosphere of sulphur dioxide. In the manufacture of sulphuric acid, the temperature of the gas is maintained at 420° C.

345,557. The process described in Specification No. 345,556 above, is modified in that a casium compound is substituted for the rubidium compound.

345,587. MOTOR SPIRIT. H. D. Elkington, London. From Benzol-Verband Ges., 45, Wittenerstrasse, Bochum, Germany. Application date, June 20, 1930.

The aromatic amines obtained by directly nitrating and reducing hydro-carbon mixtures obtained by dry distillation of coal are used as an anti-knocking addition to benzine motor fuels.

345,591. NITRIC ACID. Lodge-Cottrell, Ltd., George Street Parade, Birmingham. From Metallges Akt.-Ges., 45, Bockenheimer Anlage, Germany. Application date, June 27, 1930.

Vapours containing nitric acid are passed through towers irrigated with acid between which electrical precipitators are arranged.

345,594. Sulphur. S. Hunyady, 35, Bethlen-u., Ráko-spalota, and K. Koller, 27, Podmaniczky-u., Budapest, both in Hungary. July 2, 1930.

Industrial gas containing sulphur is passed through an aqueous suspension of manganic oxide, with the formation of manganese sulphide and sulphur, which are filtered out. The moist mass is oxidised with air to manganese hydrate and sulphur, and then dried in warm air to convert the hydrate to oxide. The sulphur is extracted with trichlorethylene and the manganic oxide used again.

345,596. PURIFYING HYDROCARBON OILS. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij, 30, Carel Van Bylandtlaan, The Hague. Assignees of R. I. Lewis, c/o Shell Oil Co., Wilmington, Cal., U.S.A. International Convention date, July 15, 1929.

International Convention date, July 15, 1929.

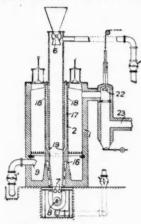
Hydrocarbon oils or petroleum fractions are treated at atmospheric temperature with sulphuric acid of 31 per cent. strength, and then at 15–20 °F. with concentrated sulphuric acid. A further treatment with the concentrated acid may follow at atmospheric temperature, and the oil, freed from sulphur, is distilled with steam and fractionated.

345,626. FATTY ACIDS. H. P. Kaufmann, 18, Hilgenfeldweg, Jena, Germany. International Convention date, December 27, 1928.

Fatty acids, fats, or esters, are subjected to simultaneous hydrolysis and catalytic hydrogenation. Mixtures containing any desired proportion of fatty acids are obtained by stopping the reaction before complete hydrogenation. A mixture of fat with a nickel catalyst is treated with a mixture of steam and hydrogen, filtered hot and allowed to settle, and the solidified acid separated. Another example is given of the treatment of methyl ester of oleic acid to obtain stearic acid, and also of the treatment of cotton-seed oil, earth nut oil, and linseed oil. Reference has been directed by the Comptroller to Specifications Nos. 5112/82, 2798/83, 3658/83, 5715/09, and 16260/09.

345,629. Endothermic Reactions. Soc. d'Etudes et Realisation dite Ereal, 71, Canal d'Hanswyck, Malines, Belgium. International Convention date, December 27, 1928.

Endothermic reactions are conducted in a chamber surrounded by a combustion chamber such as a gas producer. In the application to the manufacture of sodium cyanide by



345,629

reaction between sodium carbonate, carbon, and nitrogen, the gas producer 1 contains the reaction chamber 2 having passages 17 in its walls connected at 18 with the producer and at 19 with the retort. The solid raw materials are fed to the retort by the distributor 6, and the products are discharged at 8. Air is supplied to the producer through conduit 9 and also inlets 16, and the producer gas is discharged at 23. At the maximum temperature the air is shut off and nitrogen supplied through inlets 16 to the producer and thence into the retort. A modification for the reduction of zinc oxide is described.

345,632. DEWAXING MINERAL OILS. Indian Refining Co. Lawrenceville, Ill., U.S.A. International Convention date, October 18, 1928.

Crude petroleum oil is distilled under reduced pressure to obtain a fraction containing wax and boiling at 400° – 620° F. This is mixed with a selective solvent, preferably a mixture of acetone and benzol, and the solution cooled to -5° F. The solvent dissolves the fraction completely at 90° F., and the solid components are precipitated at -5° F. The mixture is passed through a filter press to remove the wax, and the solvent is then distilled off. The residue is freed from sulphur by treating with sulphuric acid, washed with alkali, and centrifuged. A lubricating oil is obtained,

345,649. CATALYSTS; METHANOL, British Celanese, Ltd., 22, Hanover Square, London, W. Bader and E. B. Thomas, of British Celanese, Spondon, near Derby. Application date, September 18, 1929.

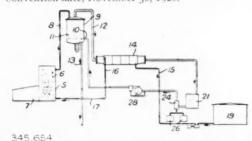
Catalysts consisting of oxides or hydroxides of zinc, chromium or cobalt are obtained by electrolysis of the solutions of the corresponding metal salts, at a temperature below 30°C, whereby the products are in a highly colloidal state. These catalysts are particularly applicable for the synthesis of methyl alcohol from carbon monoxide and hydrogen, and also for oxidation, reduction, hydrogenation and dehydration reactions. The nitrates or formates may be electrolysed, with a voltage of at least 20 volts. In an example, a solution of zine and chromium nitrates in the atomic proportions of 3-4:1 is passed through the cathode compartment of a cell, and the liquid containing colloidal zine and chromium oxides is passed to a settling tank. A zine cathode and a magnetic anode in a bag of filter cloth are employed. The mixture of hydroxides is thickened by filtering or pressing; shaped into pellets, dried, heated in a reducing atmosphere, and used for the synthesis of methanol. Details of the electrolytic process are given.

345,650-1. DYES. J. Y. Johnson, London, From I.G* Farbenindustric Akt.-Ges., Frankfort-on-Main, Germany Application date, September 23, 1929, and October 14, 1929.

345.650. 3:4:8:9-Dibenzopyrene-5:10-quinone of its derivatives are treated with halogen or a halogenating agent in the presence of an organic solvent or diluent, and one or more halogen transferers. Alternatively the quinone or its derivatives may be treated in aqueous suspension. Catalysts such as iron, copper or their compounds, sulphur, phosphorus and iodine may be employed. Bromination by this method yields monobroms derivatives, but monochloro derivatives require the use of only the theoretical proportion of chlorine. The halogenation of 3:4:8:9-dibenzopyrene-5:10-quinone and several derivatives is described. The products dye cotton yellow to yellow-red shades.

This is an addition to 341,884. Bromo-Bzl: 345,651. Pyl1-2: 21-benzanthrone-pyrazolanthrones obtained according to specification 341,884 are condensed with a single organic compound containing a replaceable hydrogen or metal atom attached to a nitrogen, oxygen or sulphur atom so that substantially all bromine is replaced by the same organic residue, the condensation being effected in the presence of high boiling diluents, acid-binding agents, and catalysts such as copper, copper acids, nickel, nickel carbonate and silver oxide. The amino derivatives obtained may be further alkylated, acylated or condensed by alkaline or acid condensing agents. carbazolisation may be effected by sulphuric acid and manganese dioxide, aluminium chloride with or without sodium chloride, or caustic alkali. Examples are given of condensations with 1-amino-anthraquinone, 2-aminoanthraquine, 1-amino-4-benzoylamino-anthraquinone, benzamide, substituted benzamides, naphthalene carboxylic acid amides, anthraquinone carboxylic acid amides and others.

345.654. DISTILLING TAR. Barrett Co., 40, Rector Street, New York. Assignees of G. T. Gambrill, 1022, South 43rd Street, Birmingham, Ala., U.S.A., International Convention date, November 30, 1928.



Tar is heated in a coiled pipe still 6, vaporised in a chamber 9, and the vapour, pitch, and residual tar brought into contact with an inert gas, which may be preheated, introduced through pipe 10. The vapour passes to heat interchanger 14 cooled by indirect contact with tar from a tank 19, and thence to

condenser 21 and receivers 26. The gases pass to a separator 24 and thence to a pump 28 to be supplied as inert gases to the

Specifications Accepted with Date of Application

349.934. Compounds from indene and phenols, Manufacture of A. Carpmael. (I.G. Farbenindustrie Akt.-Ges.). February 28, Addition to 297,075 1930.

349,956. Condensation products of formaldehyde with aromatic sulphonamides and N-arvl derivatives thereof, Manufacture of. Monsanto Chemical Works. December 31, 1928.
349,958. Gas reactions at high temperatures, Process and apparatus for carrying out. Imperial Chemical Industries, Ltd., T. S. Wheeler, and W. B. Fletcher. January 27, 1930.

y,988. Emulsions of resins of the polyhydric alcohol polybasic acid type, and the application thereof. Imperial Chemical Industries, Ltd., and W. Baird. December 27, 1929.

into hydrocarbons having a lower boiling point by destru hydrogenation. Gas Light and Coke Co., and R. H. Griffith. January 25, 1930.

349,998. Ammonium-nitrate ammonium-sulphate mixed fertilisers, Production of, Ruhrchemie Akt.-Ges. February 23, 1929. 350,010. Ethers from alcohols, Manufacture of, H. D. Elkington. (Naamlooze Vennootschap de Bataafsche Petroleum Maat-

(Naamlooze Vennootschap de Bataafsche Petroleum Maat-schappij). March 5, 1930. Addition to 23648 1929. (O21-2. Aluminium alloy. H. C. Hall and T. F. Bradbury. March 8, 1930. 350,021 addition to 323,353 and 350,022 addi-

tion to 334430. 350,048-9. Steel, Manufacture of. D. Colville and Sons, Ltd., and A. McCance. March 12, 1930.

350,050. Sulphates, Production of. Metallges. Akt.-Ges., C. B. Von. Girsewald, and E. Stahl. March 13, 1930.
350,086. Complete roasting of sulphur ores and other sulphur containing substances, Process for. O. Saladin. March 21,

1930.
350,110. Aluminium alloy. H. C. Hall. April 1, 1930.
350,120. Purification of gases for synthesis of ammonia. Soc. l'Air
Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude. July 9, 1929.
350,124. Sulphur, Production of. D. Tyrer, and Imperial
Chemical Industries, Ltd. April 4, 1930.
350,135. Recovery of molybdenum from mixtures of molybdenum

or molybdenum compounds with other metals or metal compounds. J. Y. Johnson. (I.G. Farbenindustrie Akt.-Ges.)

pounds. J. Y. Johnson. (I.G. Farbenindustrie Art.-Ges.), April 14, 1930. 350,161. Vulcanisation of rubber. Imperial Chemical Industries, Ltd., H. M. Bunbury, W. J. S. Naunton, and W. A. Sexton. April 29, 1930.

April 29, 1930.
350,167. Thermal process for the production of a fertiliser consisting of lime phosphate. A. Buchleitner. April 30, 1929.
350,343. Sodium nitrate and ammonium chloride, Production of Chemieverfabren-Ges. October 3, 1929.
350,357. Aluminium alloys. Ruselite Corporation. April 25,

Applications for Patents

[In the case of applications for patents under the International Convention, the priority date (that is, the original application date abroad which the applicant desires shall be accorded to the patent) is given in brackets, with the name of the country of origin. Specifications of such applications are open to inspection at the Patent Office on the anniversary of the date given in brackets, whether or not they have been

1930

Beli, H. S. Dye Vats. 17.645. June 18.
Biott, J. F. T.; Coles Products, Ltd.; Firmin, L. W. G.; Gabriel,
L. G.; Peard, W. L. Treating materials capable of undergoing dispersion in water and for obtaining aqueous dispersions going dispersion in the second of the second second

Buckle

June 18. Carpmael, A. (I.G. Farbenindustrie Akt.-Ges.). conversion products of higher paraffin hydrocarbons. 17,825. Tune to. (February 6.)

June 19. (February 6.)

— Manufacture of conversion products of higher paraffin hydrocarbons. 17.858. June 19. (February 6.)

Coley, H. E. Reduction of ores, oxides, etc. 17.335. June 15.

— Manufacture of zinc, etc. 17.696. June 18.

Compagnie Internationale pour la Fabrication des Essences et Pétroles. Treatment of heavy oils, etc., for conversion into lighter products. 17,303. June 15. (France, June 16, 1930.) Dreyfus, H. Treatment or manufacture of hydrocarbons. 17,797.

Du Pont de Nemours and Co., E. I. Nitrocellulose conting composition. 17,863, 17,864. June 19. (United States, June 19.)

Fairweather, D. A. W., and Imperial Chemical Industries, Ltd. Dves and dveing. 17,865. June 19.

Converting into soluble salts lead, etc., contained in ores.

n ores. 17,376. June 15. (France, June 17, 1930.) Treatment of ores containing lead. 17,377. June 15. (France, June 18, 1930.)
- Producing compounds of lead. 17,378. June 15. (France,

June 19, 1930.) Manufacture of metallic lead. 17.379. June 15. (France,

June 17, 1930.)

Goldberg, A. A. Manufacture of anthraquinone derivative. 17,676. June 18. Goodeve, C. F. Removal of sulphur dioxide from gases. 17,807.

June 19. Herrmuth, E. Preparation of fertiliser. 17,530. June 17.

(Germany, June 27, 1930.) Aluminium alloys. 17,306. June

I.G. Farbenindustrie Akt.-Ges. Aluminium alloys. 17,306. June 15. (Germany, June 16, 1930.)
— Aluminium alloy resistant to action of seawater. 17,397. June 15. (Germany, August 21, 1930.)

Manufacture of alkylesters of carboxylic acids. 17.473-

June 16. (Germany, June 16, 1930.)

- Manutacture of artificial threads from cellulose derivatives.

17,580. June 17. (Germany, June 17, 1930.)

- Manufacture of irradiated ergosterol. 17,734. June 18. (Germany, June 18, 1930.)

Imperial Chemical Industries, Ltd., and Jones, D. C. R. Production

Johnson, J. Y. (1.G. Farbenindustries Akt.-Ges.). Apparatus for the recovery of hydrogen from gases. 17,912. June 20.

Mentzel, A. Manufacture of alkali nitrate and hydrochloric acid.

17,329. June 15. (Germany, July 22, 1930.)

Mond, A. L. (I.G. Farbenindustrie Akt.-Ges.). Producing caustic soda. 17,288. June 15.
Patrick, J. C. Manulacture of olefin-polysulphide plastics. 17,721. June 18. (United States, August 8, 1930.)

Pearce, S. L. Removal of sulphur dioxide from gases. 17,807. June 19.

Pfizer and Co., C. Crystalline anhydrous citric acid. 17.853. June 19. (United States, January 7.) Silica Gel Corporation. Catalytic agents. 17.515. June 16.

(United States, June 17, 1930.)

Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Manufacture of sodium silicate. 17.478. June 16. (France, July 21, 1930.)

17.478. June 16. (France, July 21, 1930.)
Thorpe, J. F. Manufacture of anthraquinone derivatives. 17.676. June 18.

Urbain, E. Manufacture of ammonium magnesium phosphatic ertilisers. 17,587. June 17. (France, June 28, 1930.)

- Manufacture of ammonium magnesium phosphatic fertilisers. 17,587. June 17. (France, November 15, 1930.)

17.587. June 17. (France, November 15, 1930.) Wanka, L. Manufacture of vat dyestuffs. 17.345. June 15.

Modern Air Conditioning Plant

Automatic Control of Temperature and Humidity The importance of air conditioning for all kinds of industries does not require emphasis, but it is essential for the best results to ensure absolutely constant temperature and humidity. In most cases hand control of air conditioning is not satisfactory. and elimination of the latter is one of the most valuable points in the new "Sirocco" air conditioning equipment, introduced by Davidson and Co., Ltd., of Belfast, who have now issued a special catalogue on the subject.

The plant is equipped with two separate thermostatic devices, which give a definite and automatic control within extremely fine limits, to a degree quite impossible with hand operation, even apart from the convenience. The whole equipment is in the form of a horizontal, rectangular casing. embodying a preliminary air heater, spray water heater, air washer, main air heater, and electric driven fan with the two thermostatic controls. Steam is used as the heating medium on the usual lines, and the preliminary air heater raises the temperature of the incoming air to any predetermined figure, while the air washer is a water spray chamber with stainless steel atomisers and a centrifugal pump in the circuit, operating at 25 lb. per square inch pressure, which cleans the air and completely saturates it with moisture. At this stage the first thermostatic regulator comes into action, maintaining the required dew point temperature by altering through a diaphragm device the steam supply to the water heater.

This new air conditioning plant is supplied in 15 standard sizes, with capacities of from 4000-60,000 cubic feet per minute

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£18 15s. per ton d/d address U.K. in casks.

ACID CHROMIC.—11d. per lb., less 2½% d/d U.K.

ACID HYDROCHLORIC.—Spot, 3s. 9d. to 6s. carboy d/d, according to purity, strength and locality.

ACID NITRIC, 80° Tw.—Spot, £20 to £25 per ton makers' works, according to district and quality.

ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

AMMONIA (ANHYDROUS).—Spot, 10d. per lb., d/d in cylinders.

AMMONIUM BICHROMATE.—8½d. per lb. d/d U.K., or 8d. c.i.f. export BISULPHITE OF LIME.—£7 10s. per ton, f.o.r. London, packages free.

BISULPHITE OF LIME.—£7 10s. per ton, f.o.r. London, packages free. BLEACHING POWDER, 35/37%.—Spot, £7 19s. per ton d/d station in casks, special terms for contracts.

BORAX, COMMERCIAL.—Crystals, £13 10s. per ton; granulated, £12 10s. per ton; powder, £14 per ton. (Packed in 1 cwt. bags. carriage paid any station in Great Britain. Prices quoted are for one ton lots and upwards.)

CALCIUM CHLORIDE (SOLID), 70/75%.—Spot, £4 15s. to £5 5s. per ton d/d station in drums.

CHROMIUM OXIDE.—9d.to 9\frac{1}{2}d. per lb. according to quantity d/d U.K. CHROMETAN.—Crystals, 3\frac{1}{2}d. per lb. Liquor, \frac{1}{2}18 12s. 6d. per ton d/d

COPPER SULPHATE.—£25 to £25 10s. per ton.
METHYLATED SPIRIT 61 O.P.—Industrial, 1s. 11d. to 2s. 4d. per gall.; pyridinised industrial, 2s. 1d. to 2s. 6d. per gall.; mineralised, 3s. to 3s. 4d. per gall. 64 O.P., 1d. extra in all cases. Prices according to quantity.

NICKEL SULPHATE.—£38 per ton d/d.

NICKEL AMMONIA SULPHATE.—£38 per ton d/d.

Potash Caustic.—£30 to £33 per ton.

Potash Caustic.—£30 to £33 per ton.

Potassium Bichromate Crystals and Granular.—4½d. per lb.

nett d/d U.K., discount according to quantity: ground ½d. per

nett d/d U.K., discount according to quantity: ground \(\frac{1}{2}d \), per lb. extra.

Potassium Chlorate.—\(3\frac{1}{4}d \), per lb. ex-wharf, London, in cwt. kegs. Potassium Chromate.—\(8\frac{1}{4}d \), per lb. d/d U.K., or 8d. c.i.f. export. Salammonia.—\(First slump \), spot, \(\frac{1}{2}d \) i7s. 6d. per ton d/d address in barrels. Chloride of ammonia, \(\frac{1}{3}d \) to \(\frac{1}{4}d \) per ton, carr. paid. Salt Cake, Unground.—Spot, \(\frac{1}{3}d \) ios. per ton d/d station in bulk. Soda Ash, \(58\frac{1}{6}d \).—Spot, \(\frac{1}{6}d \) per ton, f.o.r. in bags, special terms for contracts. for contracts.

Soda Caustic, Solid, 76/77°E.—Spot, £14 10s. per ton, d/d station. Soda Crystals.—Spot, £5 to £5 5s. per ton, d/d station or ex depot in 2-cwt. bags.
Sodium Acetate 97/98%.—£21 per ton.

SODIUM ACETATE 97/98%.—£21 per ton. SODIUM BICARBONATE, REFINED.—Spot, £10 10s. per ton d/d station in hags

SODIUM BICHROMATE CRYSTALS (CAKE AND POWDER) -31d. per lb. nett d/d U.K., discount according to quantity. Anhydrous ad. per lb. extra.

Sodium Bisulphite Powder, 60/62%.—£16 ios. per ton delivered

1-cwt. iron drums for home trade.

I-cwt. iron drums for home trade.

Sodium Chlorate.—2\frac{1}{3}d. per lb.

Sodium Chromate.—3\frac{1}{3}d. per lb. d/d U.K., or 3\frac{1}{3}d. c.i.f. export.

Sodium Nitrite.—Spot, \(\frac{1}{3} \) per ton, d/d station in drums.

Sodium Phosphate.—\(\frac{1}{3} \) tall per ton, f.o.r. London, casks free.

Sodium Silicate, 140° Tw.—Spot, \(\frac{1}{3} \) 5s. per ton, d/d station returnable drums.

Sodium Sulphate (Glauber Salts).—Spot, \(\frac{1}{4} \) 2s. 6d. per ton,

d/d.

SODIUM SULPHIDE SOLID, 60/62%.—Spot, £10 5s. per ton, d/d in free drums. Crystals—Spot, £8 5s. per ton, d/d in free casks.

Sodium Sulphite, PeaCrystals.—Spot, £13 ios. per ton, d/d station in kegs. Commercial—Spot, £9 per ton, d/d station in bags.

Coal Tar Products

Coal Tar Products

Coal Tar Products

ACID CARBOLIC CRYSTALS.—5d. to 6\frac{1}{4}d. per lb. Crude 6o's is. to is. id. per gall. August/December.

ACID CRESYLIC 99/100.—1s. 9d. to is. iod. per gall. B.P., 3s. 6d. per gall. 97/99.—Refined, 2s. 2d. to 2s. 3d. per gall. Pale, 98%, is. 7d. to is. 8d. Dark, is. 4d. to is. 4\frac{1}{4}d.

ANTHRACENE OIL, STRAINED (GREEN OIL).—4\frac{1}{4}d. to 4\frac{3}{4}d. per gall. Standard Motor is. id to is. 3d per gall. 30\frac{1}{2}d. per gall. The standard of the standar Motor, is. id. to is. 2d. per gall. 90%.—is. 2d. to is. 3d. per gall. Pure, is 5d. to is. 6d. per gall.

TOLUOLE.—90%, is. 8d. to is. 9d. per gall. Pure, is. iod. to is. iid.

per gall.

per gall.

XVIOL.—1s. 8d. to 1s. 9d. per gall. Pure, 1s. 10d to 1s. 11d. per gall.

CREOSOTE.—Standard specification, for export, 5dd. to 5dd. net per gall. f.o.b.; for Home, 4d. per gall. d/d.

Naphtha.—Solvent, 90/160, 18. 3d. per gall. Solvent, 95/160, 1s. 4d. to 1s. 5d. per gall. Solvent, 90/190, 1s. to 1s. 2d. per gall.

Naphthalene.—Purified Crystals, £10 per ton.
PITCH.—Medium soft, 45s. to 47s. 6d. per ton, in bulk at makers'

Pyridine.—90/140, 3s. to 3s. 3d. per gall. 90/160, 3s. 3d. to 3s. 6d. per gall. 90/180, is. 9d. to 2s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:—

ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.

ACID ANTHRANLIC.—6s. per lb. 100%.

ACID GAMMA.—Spot, 3s. 3d. per lb. 100% d/d buyer's works.

ACID H.—Spot, 2s. 3d. per lb. 100% d/d buyer's works.

ACID NAPHTHIONIC.—1s. 2d. per lb. 100% d/d buyer's works.

ACID NEVILLE AND WINTHER.—Spot, 2s. 6d. per lb. 100% d/d

buver's works. ACID SULPHANILIC.—Spot, 8\flat. per lb. 100\(^0\), d/d buyer's works.

ANILINE OIL.—Spot, 8\flat. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8\flat. per lb. d/d buyer's works, casks free.

BENZALDEHYDE.—Spot, 1s. 6\flat. per lb., packages extra, d/d buyer's

works.

Benzidine Base.—Spot, 2s. 3d. per lb. 100% d/d buyer's works. BENZOIC ACID.—Spot, 18. 84d. per lb. d/d buyer's works. o-Cresol 30/31° C.—£2 6s. 5d. per cwt., in 1-ton lots. m-Cresol 34;5° C.—£2 6s. 5d. per cwt., in ton lots. p-Cresol 34;5° C.—18. 9d. per lb., in ton lots. Dichloraniline.—2s. 5d. per lb.

DIMETHYLANILINE.—Spot, is. 6d. per lb., packages extra, d/d buver's works.

DINITROBENZENE.—7½d. per lb.
DINITROCHLORBENZENE.—£74 per ton d/d.
DINITROTOLUENE.—48/50° C., 7d. per lb.; 66/68° C., 7¼d. per lb.
DIPHENYLAMINE.—Spot, is. 8d. per lb. d/d buyer's works.

a-Naphthol.—Spot, is. 9d. per lb. d/d buyer's works. B-Naphthol.—Spot, 165 per ton in 1 ton lots, d/d buyer's works.
a-Naphthylamine.—Spot, 101d. per lb. d/d buyer's works.
B-Naphthylamine.—Spot, 2s. 9d. per lb. d/d buyer's works.

D-NATRANLLINE.—550.t, 2s. 9d. per lb. d/d buyer's works.
o-NITRANLLINE.—55. 11d. per lb.
m-NITRANLLINE.—Spot, 2s. 6d. per lb. d/d buyer's works.
p-NITRANLLINE.—Spot, 1s. 8d. per lb. d/d buyer's works.
NITROBENZENE.—Spot, 6½d. per lb., 5-cwt. lots, drums extra, d/d buyer's works.

Nitronaphthalene.—84d. per lb. R. Salt.—Spot, 2s. per lb. 100% d/d buyer's works.

SODIUM NAPHTHIONATE. - Spot, 1s. 6d. per lb. 100% d/d buyer's works.

o-Toluidine.—Spot, 8d. per lb., drums extra, d/d buyer's works. p-Toluidine.—Spot, is. 6d. per lb. d/d buyer's works. m-Xylidine Acetate.—3s. 3d. per lb., 100%.

Wood Distillation Products

WOOD DISTIllation Products

ACETATE OF LIME.—Brown, £7 5s. to £7 10s. per ton. Grey, £13
per ton. Liquor, 9d. per gall.

ACETONE.—£63 to £65 per ton.

CHARCOAL.—£6 to £8 10s. per ton.according to grade and locality.

IRON LIQUOR.—24°30° Tw., 10d. to 1s. 2d. per gall.

RED LIQUOR.—16° Tw., 8½d. to 10d. per gall.

WOOD CREOSOTE.—1s. 9d. per gall., unrefined.

WOOD NAPHTHA, MISCIBLE.—2s. 9d. to 2s. 11s. per gall., according to quantity. Solvent, 3s. 9d. per gall.

WOOD TAR.—£4 to £5 per ton. to quantity. Solvent, 3s. 9d. per Wood Tar.—£4 to £5 per ton. Brown Sugar of Lead.—£32 per ton.

Rubber Chemicals

Antimony Sulphide.—Golden, 6d. to 1s. 1d. per lb according to quality; Crimson, 1s. 3d. to 1s. 5d. per lb., according to quality. Arsenic Sulphide, Yellow.—1s. 5d. to 1s. 7d. per lb. Barytes.—£6 to £7 10s. per ton, according to quality. Cadmium Sulphide.—4s. 6d. to 5s. per lb.

CARBON BISULPHIDE. - £26 to £28 per ton, according to quantity; drums extra.

CARBON BLACK.—3d. to 4d. per lb., ex wharf.
CARBON TETRACHLORIDE.—£40 to £50 per ton, according to quantity: drums extra. CHROMIUM OXIDE, GREEN.-

-is, 2d. per lb.

DIPHENYLGUANDINE.—28. 6d. per lb.
INDIARUBBER SUBSTITUTES, WHITE.—4 %d. to 5 d. per lb.; Dark, And to 4%d. per lb.; Dark, 4kd. to 4%d. per lb.; Dark, 4kd. to 4%d. per lb.; Dark, 4kd. to 4%d. per lb.; Dark, Lamp Black.—£28 per ton, barrels free.
Lithopone, 30%.—£18 to £20 per ton.
Sulphur.—£9 los. to £13 per ton, according to quality.
Sulphur Chloride.—4d. to 7d. per lb., carboys extra.
Sulphur Precip. B.P.—£55 to £60 per ton, according to quantity.
Vermilion, Pale or Deep.—6s, 4d. to 6s. lod. per lb.

ZINC SULPHIDE .- 8d. to 11d. per lb.

Pharmaceutical and Photographic Chemicals
ACETANILIDE.—18. 4½d. to 18. 6d. per lb.
ACID, ACETIC, PURE, 80%.—£37 58. per ton d/d address U.K. in casks.

ACID, ACETYL SALICYLIC .- 25. 7d. to 2s. 9d. per lb., according to quantity.

quantity.

Acip, Benzoic B.P.—is. 10d. per lb., for synthetic product. Solely ex Gum, is. 3d. to is. 6d. per oz.; 50-oz. lots, is. 3d. per oz.

Acip, Boric B.P.—Crystal, £31 per ton; powder, £32 per ton; For one-ton lots and upwards. Packed in 1-cwt. bags carriage paid any station in Great Britain.

ACID, CAMPHORIC .- 19s. to 21s. per lb.

ACID, CAMPHORIC.—198. to 218. per lb.

ACID, CITRIC.—11\frac{1}{2}\d. per lb., less 5\%.

ACID, GALLIC.—28. 11d. per lb. for pure crystal, in cwt. lots.

ACID, MOLYBDIC.—58. 3d. per lb. in \frac{1}{2}\-cwt. lots.

Packages extra.

Special prices for quantities and contracts.

ACID, PYROGALLIC, CRYSTALS.—78. 3d. per lb. for 28-lb. lots.

ACID, SALICYLIC, B.P. PULV.—18. 5d. to 18. 8d. per lb. Technical are 18. 2d. per lb.

ACID, SALICYLIC, B.P. PULV.—Is. 5d. to 1s. 8d. per lb. Technical.—1s. to 1s. 2d. per lb.

ACID, TANNIC B.P.—2s. 8d. to 2s. 1od. per lb.

ACID, TARTARIC.—11½d. per lb., less 5%.

AMIDOL.—7s. 6d. to 11s. 3d. per lb., according to quantity.

AMMONIUM BENZOATE.—3s. 6d. per lb.

AMMONIUM CARBONATE B.P.—£36 per ton. Powder, £39 per ton in 5-cwt. casks. Resublimated, 1s. per lb.

AMMONIUM MOLYBDATE.—4s. 9d. per lb. in ½-cwt. lots. Packages extra. Special prices for quantities and contracts.

ARGENT. NITRAS, CRYSTALS.—1s. 1d. per oz.

ATROPHINE SULPHATE.—7s. to 7s. 6d. per oz., according to quantity.

BARBITONE.—5s. 9d. to 6s. per lb.

ATROPHING SUPPARIE—75. 07. 00. DP BARBITONE.—55. 9d. to 6s. per lb. BENZONAPHTHOL.—2s. 1od. per lb. BISMUTH CARBONATE.—75. 3d. per lb. BISMUTH CITRATE.—8s. 4d. per lb. BISMUTH SALICYLATE.—7s. 7d. per lb. BISMUTH SUBNITRATE.—6s. 6d. per lb.

BISMUTH SUBNITARIE.—9s. 6d. per lb.
BISMUTH NITRATE.—10s. 4d. per lb.
BISMUTH NITRATE.—10s. 4d. per lb.
BISMUTH SUBCHICKIDE.—10s. per lb.
BISMUTH SUBCHICKIDE.—10s. per lb.
BISMUTH SUBCHICKIDE.—10s. per lb.
BISMUTH SUBCHICKIDE.—7s. 6d. per lb. Extra and reduced prices for smaller and larger quantities of all bismuth salts respectively.
BISMUTH ET AMMON LIQUOR.—Cit. B.P. in W. Qts. 1s. 4d. per lb.; 12 W. Qts. 11\frac{1}{2}d. per lb.; 36 W. Qts. 11d. per lb. Liquor Bismuth B.P., in W. Qts., 1s. 2d. per lb.; 6 W. Qts., 11\frac{1}{2}d. per lb.; 12 W. Qts., 10d. per lb.; 36 W. Qts., 94d. per lb.
BORAX B.P.—Crystal, \(\frac{1}{2} \text{2} \text{1 ios. per ton: powder, } \frac{1}{2} \text{2} \text{ per ton: for one-ton lots and upwards. Packed in 1-cwt. bags carriage paid any station in Great Britain.
BROMIDES.—Ammonium, 1s. 9d. per lb.; potassium, 1s. 4\frac{1}{2} \text{d. per lb.; granular, 1s. 5d. per lb.; sodium, 1s. 7d. per lb. Prices for 1-cwt. lots.

CAFFEIN, PURE.—6s. 6d. per lb.
CALCIUM LACTATE.—B.P., 1s. 1\frac{1}{2} \text{d. to 1s. 3d. per lb., according to quantity.}

quantity.

Camphor.—Refined flowers, 2s. 10d. to 3s. per lb., according to

quantity; also special contract prices.

CHLORAL HYDRATE.—28. 11½d. to 3s. 1½d. per lb.

CHLOROFORM.—2s. 3d. to 2s. 6d. per lb., according to quantity.

ETHERS.—S.G. 730—1s. 1d. to 1s. 2d. per lb., according to quantity;

other gravities at proportionate prices.

FORMALDEHYDE, 40%.—30s. per cwt., in barrels, ex wharf. Glucose, Medicinal.—is. 6d. to 2s. per lb. for large quantities.

HEXAMINE.—1s. 10d. to 2s. per lb., according to quantity.

HYDROGEN PEROXIDE (12 VOLS.).—1s. 4d. per gallon, f.o.r. makers'

works, naked. B.P., 10 vols., 2s. to 2s. 3d. per gall.; 20 vols., 3s. per gall.

HYDROQUINONE.—3s. 9d. to 4s. per lb., in cwt. lots.

HYPOPHOSPHITES.—Calcium, 2s. 11d. to 3s. 4d. per lb.; potassium,
3s. 2d. to 3s. 7d. per lb.; sodium, 3s. 1d. to 3s. 6d. per lb.; for 28-lb. lots.

IRON AMMONIUM CITRATE.—B.P., IS. 9d. per lb., for 28-lb. lots.
Green, 2s. 6d. per lb., list price. U.S.P., 2s. 7d. per lb. list price.
IRON PERCHLORIDE.—18s. to 20s. per cwt., according to quantity.
IRON QUININE CITRATE.—B.P., 8\flat{1}d. to 8\frac{3}{4}d. per oz., according to

Magnesium Oxide.—Light B.P., 36s. per cwt.

Magnesium Oxide.—Light Commercial, £62 10s. per ton, less 21%;

MAGNESIUM ONIDE.—Light Commercial, £62 10s. per ton, less 2½%; Heavy commercial, £21 per ton, less 2½%; in quantity lower; Heavy Pure, 2s. to 2s. 3d. per lb.

MENTHOL.—A.B.R. recrystallised B.P., 14s. 6d. per lb. net; Synthetic, 8s. 6d. to 12s. per lb.; Synthetic detached crystals, 8s. 6d. to 10s. per lb., according to quantity; Liquid (95%), 9s. per lb.

MERCURIALS B.P.—Up to 1-cwt. lots, Red Oxide, crystals, 8s. 4d. to 8s. 5d. per lb., levig., 7s. 10d. to 7s. 11d. per lb.; Corrosive Sublimate, Lump, 6s. 7d. to 6s. 8d. per lb., Powder, 6s. to 6s. 1d. per lb.; Wbite Precipitate, Lump, 6s. 9d. to 6s. 10d. per lb., Powder, 6s. 10d. to 7s. per lb.; Calomel, 7s. 2d. to 7s. 3d. per lb.; Yellow Oxide, 7s. 8d. to 7s. 9d. per lb.; Persulph, B.P.C., 6s. 11d. to 7s. per lb.; Sulph. nig., 6s. 8d. to 6s. 9d. per lb. Special prices for larger quantities. larger quantities.

METHYL SALICYLATE.—Is. 3d. to is. 5d. per lb.
PARAFORMALDEHYDE.—Is. 6d. per lb.
PARALDEHYDE.—Is. id. per lb.
PHENACETIN.—3s. 9d. to 4s. id. per lb.
PHENALEIN.—5s. to 5s. 2½d. per lb.
POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—8is. per cwt.,

POTASSIUM BITARRATE 99/100% (Cream of Tartar).—81s. per cwt., less 2½ per cent.

POTASSIUM CITRATE.—B.P., is. 7d. per lb. for 28-lb. lots.

POTASSIUM FERRICYANIDE.—1s. 7½d. per lb., is 125-lb. kegs

POTASSIUM IODIDE.—16s. 8d. to 17s. 9d. per lb., as to quantity.

POTASSIUM METABISULPHITE.—50s. per cwt. d/dLondon, kegs free.

POTASSIUM PERMANGANATE.—B.P. crystals, 5½d. per lb., spot.

QUININE SULPHATE.—1s. 8d. per oz. for 1,000-0z. lots.

SACCHARIN.—43s. 6d. per lb.

SALICIN.—16s. 6d. to 17s. 6d. per lb., according to quantity.

SANTONIN.—450 per kilo for 5-kilo lots.

SILVER NUTRATE —10d per qr. for 500-02 lots. sticks ad per ox.

SILVER NITRATE. -- Iod. per oz. for 500-oz. lots, sticks, 2d. per oz. extra

SODIUM BARBITONUM.—8s. 6d. to 9s. per lb. for 1-cwt. lots. SODIUM BENZOATE B.P.—1s. 6dd. to 1s. 7dd. per lb. SODIUM CITRATE.—B.P.C. 1911, 1s. 4d. per lb. B.P.C. 1923, and U.S.P., 1s. 8d. per lb. for 28-lb. lots.

SODIUM HYPOSULPHITE, PHOTOGRAPHIC .- £15 per ton, d/d con-

SODIUM SULPHITE, PHOTOGRAPHIC.—£15 per ton, d/d consignee's station in 1-cwt. kegs.

SODIUM NITROPRUSSIDE.—16s. per lb.

SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—75s. per cwt. net, ton lots, d/s of 5 cwt. Crystals, 2s. 6d. per cwt. extra.

SODIUM SALICYLATE.—Powder, 1s. 1od. to 2s. 2d. per lb. Crystal, 1s. 11d. to 2s. 3d. per lb.

SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 2d. per lb.

SODIUM SULPHITE, ANHYDROUS.—£26 to £28 per ton, according to quantity. Delivered U.K.

STRYCHNINE, ALKALOID CRYSTAL, 2s. per oz.; hydrochloride, 1s. 9½d. per oz.; nitrate, 1s. 8d. per oz.; sulphate, 1s. 9d. per oz., for

I,000-02 quantities.

TARTAR EMETIC, B.P.—Crystal or powder, 1s. 9d. to 2s. per lb.

THYMOL.—Puriss, 6s. 1½d. to 7s. per lb., according to quantity.

Natural, 12s. per lb.

ZINC STEARATE.is. 4d. to is. 6d. per lb.

Perfumery Chemicals

ACETOPHENONE .--7s. per lb. AUBEPINE (EX ANETHOL) .- 98. AMYL ACETATE.—2s. 3d. per lb.
AMYL BUTYRATE.—4s. 9d. per lb.
AMYL CINNAMIC ALDEHYDE.—9s. per lb.

AMYL SALICYLATE.—28. 6d. per lb.
ANETHOL (M.P. 21/22° C.).—5s. per lb.
BENZALDEHYDE FREE FROM CHLORINE.—

BENZALDEHYDE FREE FROM CHLORINE.—25. 6d. per lb.
BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—15. 3d. BENZYL ALCOHOL FREE FROM CHLORINE .- 15. 9d. per lb.

BENZYL BENZOATE .- 2s. 2d. per lb.

CINNAMIC ALDEHYDE NATURAL .- 11s. 9d. per lb.

COUMARIN.—12s. per lb.
Citronellol.—6s. 6d. per lb.
Citral.—6s. 6d. per lb.
Ethyl Cinnamate.—6s. 9d. per lb.
Ethyl Phthalate.—2s. 6d. per lb.

ETHYL PHTHALATE.—28. Od. per lb.

EUGENOL.—8s. 6d. per lb.

GERANIOL.—6s. to 10s. per lb.

HELIOTROPINE.—5s. 6d. per lb.

Iso EUGENOL.—10s. 6d. per lb.

LINALYL ACETATE, Ex BOIS DE ROSE.—7s. 6d. per lb. Ex Shui

Oil, 7s. 6d. per lb. METHYL ANTHRANILATE.—6s. 3d. per lb. METHYL BENZOATE.—48. 3d. per lb.
MUSK XYLOL.—68. 6d. per lb.
PHENYL ETHYL ACETATE.—10s. per lb.
PHENYL ETHYL ALCOHOL.—88. 3d. per lb.

PHENYL ETHYL ALCOHOL.—os. 3d. per 1b.
RHODINOL.—40s. per lb.
SAFROL—1s. 6d. per lb.
Vanillin, Ex Clove Oil.—14s. 6d. to 16s. 6d. per lb. Ex
Guaiacol.—13s. to 15s. per lb.

Essential Oils

Essential Oils

Anise Oil.—2s. 6d. per lb.
Bergamot Oil.—8s. 3d. per lb.
Bourbon Geranium Oil.—17s. 6d. per lb.
Camphor Oil.—White, 2s. per lb.; Brown, 1s. 6d. per lb.
Cannanga.—Java, 8s. per lb.
Cinnamon Oil Leaf.—4s. 6d. per oz.
Citronella Oil.—Java, 2s. 2d. per lb., c.i.f. Pure Ceylon, 2s. per lb.
Clove Oil, 90/92%.—6s. 6d. per lb.
Eucalyftus Oil, Australian, B.P. 70/75%—1s. 7d. per lb.
Lavender Oil.—Mont Blanc, 38/40%, 9s. per lb.
Lemon Oil.—4s. per lb.

LAVENDER OIL.—Mont Blauc, 30/40%, 9s. per 1b.

LEMON OIL.—4s. per lb.

LEMONGRASS OIL.—3s. 1½d. per lb.

OTTO OF ROSE.—Anatolian, 45s. per oz.; Bulgarian, 65s. per oz.

PALMA ROSA.—9s. 6d. per lb.

PEPPERMINT OIL.—Wayne County, 8s. 6d. per lb.

ROTARY COMPRESSORS AND EXHAUSTERS

of British Make

Made in Sizes 6 to 1,200 cub. ft. per minute capacity.

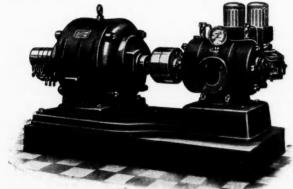
COMPRESSORS for pressures from 4 to 40 lbs. per sq. in.

EXHAUSTERS for vacuums within ·23 in. of barometer.

ABSOLUTE SIMPLICITY

HIGHEST EFFICIENCY AS a low pressure Compressor or Exhauster, the "Broomwade" Rotary Machine is super-efficient and ideal in all respects. Strikingly simple in design, it is low in first cost and power consumption, of extremely compact dimensions, whilst 10 years' actual experience with many installations of this type has proved it to give lasting and reliable service.

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BROOMWADE"
ROTARY COMPRESSORS & EXHAUSTERS

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, June 25, 1931.

INQUIRY has been somewhat brisker during the current week with one or two products showing advances. Generally speaking, however, the markets are steady.

General Chemicals

Acetone.—A fair average demand has been received for this product with the market showing a little firmer tendency at

foo to £63 per ton, according to quantity.

Acto, Acetic —Quoted unchanged at £36 5s. to £38 ss. for technical 86% and £37 5s. to £30 ss. for pure 86%, according to quantity and a fair amount of business has been placed.

ACID, CITRIC.—Continues to receive a better inquiry with price still easy at about about 1s. per lb., less 50

ACID, FORMIC.—The market is unchanged at 438 per ton and there

has been a satisfactory demand.

ACID, LACTIC.—In steady request with price slightly lower at £37 per ton for 50°, by weight pale technical quality.

ACID, ONALIC.—Continues an active market at £34 per ton, carriage

paid.

ACID, TARTARIC.—Unchanged at 11d. to 111d. per lb., less 50, with a rather better inquiry being received.

Alumina Sulphare—Unchanged at £7 15s. to £8 5s. per ton for 17/18% iron free quality and has been in good request.

Arsenic.—There is still a scarcity of Cornish material, price for which is firm at £19 to £10 10s. per ton. Imported is arriving more freely and is quoted at about £18 10s. per ton.

CREAM OF TARTAR.-Has been in better demand with the price unchanged at 80s. to 81s. per cwt., ex warehouse London.

COPPER SULPHATE.—A brisk demand has been met in this market with supplies for early delivery difficult to obtain. The market is advancing and price nominal at £21 to £21 tos. per ton, less 5 or free on rails London.

FORMALDEHYDE. - Continues in moderate demand at about #29 per ton

LEAD ACETATE.—Firmer at £31 15s. per ton for white with brown It per ton less and there is a larger volume of business passing.

LITHOPONE.—Is steady at £18 to £22 per ton according to grade and quantity, with a fairly active demands.

POTASSIUM BICHROMATE.—Unchanged at 4½d. per lb. with discounts for contracts and in regular request.

Potassium Chlorate.—The market is maintained at £28 to £32 per ton according to quantity and there is an active demand.

Permanganate of Potash.—Firm at 5½d. to 5½d. per lb., ex warehouse, for B.P. needle crystals and is in good request.

Sodium Bichromate.—Firm at 3½d. per lb., with discounts for contracts and in everyday demand.

Sodium Hyposulphite.—Photographic crystals are in good request.

at £14 58. per ton, with the commercial quality at about 48 10s per ton.

Sodium Prussiate.—Continues firm at 4\frac{3}{4}d. to 5\frac{1}{4}d. per lb., and

there is an increased demand.

Tartar Emetic.—Unchanged at told, per lb, with a fairly satisfactory demand.

ZINC SULPHATE. - Firmer and in better demand at 410 10s. per ton.

Coal Tar Products

THE market for coal tar products is still uninteresting, with THE matrice for coat tal products is still differently were little inquiry, although prices remain unaltered. Motor Benzol.—Worth is 4½d, to is, 5½d, per gallon, f.o.r. Solvent Naphtha.—Quoted at is, 1½d, to is, 2d, per gallon, f.o.r. Heavy Naphtha.—Remains at 11d, to is, 0½d, per gallon, f.o.r. Creosote Oil.—Unchanged at about 3d, to 3½d, per gallon, f.o.r. in

CREOSOTE OIL.—Unchanged at about 3d. to 34d. per gallon, 1.o.r. in the North, and at 4d. to 41d. per gallon in London.

CRESYLIC ACID.—Obtainable at about 1s. 8d. per gallon for the 98 100% quality, and at about 1s. 6d. per gallon for the dark quality 95/97%.

NAPHTHALENES.—Quoted at about £3 10s. to £3 15s. per ton for the firelighter quality, at about £4 to £4 5s. per ton for the 74/76 quality, and at about £5 per ton for the 76/78 quality.

PITCH.—Obtainable at 40s. to 42s. 6d. per ton, f.o.b. East Coast port for forward delivery.

port, for forward delivery

The following additional prices have been received:

Carbolic Acid.—There is no change—5-ton lots are still quoted at 5½d. with druggists' quantities at 6¼d. per lb. in bulk packing.

Sodium Salicylate.—Unchanged at 1s. 10½d. for powder and 18. 111d. for crystal, in 1-ton lots.

Salicylic Acid.—Crystal and powder is quoted at 1s. 5d. per lb.

in ton quantities, 5-cwt. lots at 1s. 6d., 1-cwt. at 1s. 6dd.

Methyl Salicylate.—A reduction takes place from to-day, prices
now being 1s. 3d. to 1s. 4d. per lb. according to quantity.

Saccharin.—Insoluble 550 is unchanged at 438.6d. per lb., duty paid.

Nitrogen Fertilisers

Sulphate of Ammonia.-Export.-The large producers have not sulphate of Ammonta.—Export.—The large products have not yet come to any decision regarding prices for the season 1931 32, and business in this product is at a standstill. Business for June shipment has been transacted at about £7 per ton f.o.b. U.K. port, in single bags, for best neutral quality. Home.—It is not yet known whether the new season's prices will commence to operate from July 1 or from some later period. As the consuming season is over, there is very little interest, except that large users are anxiously awaiting the new season's price scale

Nitrate of Soda.-The buyers of this product are also awaiting the new prices and business at present is negligible. It is understood that the sales in all markets during the year 1930 31 will show a decline of about 20 per cent. on that of the previous year

South Wales By-Products
South Wales by-product THERE is very little change to report in South activities. There is a slightly better call for pitch, but the demand is still far from satisfactory. Prices are unchanged. Road tar is still far from satisfactory. Prices are unchanged. Road far continues to have a fair and steady call round about 13s. per 40-gallon barrel. Refined tars are unchanged, there being a fair call for both gasworks and coke-oven tar without change in values. Naphthas are quiet, a small, sporadic call coming for solvent, but heavy having practically no call. Patent fuel exports are slightly better. Patent fuel prices, for export, are as follows:—20s. to 20s. 6d., ex-ship Cardiff; 19s. to 19s. 6d., ex-ship Swansea. Coke prices are: —Best foundry, 34s. to 36s. 6d.; good foundry, 22s. 6d. to 25s.; furnace, 16s. 6d. to 17s. 6d.

Latest Oil Prices

London.—Linseed Oil was strong. Spot £18 10s., ex mill; July, £16 15s.; July -August, £16 17s. 6d.; September-December, £17 2s. 6d.; January-April, £18, naked. Rape Oil was quiet. Crude extracted, £26 10s.; technical refined, £28; naked, ex wharf. COTTON OIL was steady. Egyptian, crude, £19; refined common edible, £21 15s.; deodorised, £23 15s., naked, ex mill. Turpentine was quiet. American, spot, 47s.; July-December,

478. 6d., per cwt.

HULL, June 24.—LINSEED OIL.—Spot and June quoted £17 10s.;

July-December, £17 5s.; January-April, £17 15s. per ton, naked.

COTTON OIL.—Bombay, crude, spot, unquoted. Egyptian, crude, spot, £19 10s.; edible refined, spot, £21 15s.; technical, spot, spot, £19 10s.; editie fenned, spot, £21 15s.; technical, spot, £21 10s.; deodorized, £23 15s. per ton. PALM KERNEL OIL.—Crushed-extracted, spot, £23; deodorized, £27 per ton. Soya Oil.—Crushed-extracted, spot, £18; deodorized, £21 10s. per ton. Rape Oil.—Crushed-extracted, spot, £18; deodorized, £21 10s. per ton. Castor Oil.—Crushed-extracted, spot, £26; refined, £28 per ton. Castor Oil.—Pharmacy spot, 40s.; first, 35s.; seconds, 33s. per cwt. Cod Oil, 18s. Turpentine, 49s. 3d. per cwt.

Scottish Coal Tar Products

WHILE distillers are maintaining their quotations at previous levels, few orders are being placed, excepting in good grades of creosote. Refined tar deliveries ex contract are increasing.

Cresylic Acid.—Market remains dull, but stocks in this area are

not too high. Pale, $99\,^\circ100^\circ_{\odot}$, is. 5d. to is. 6d. per gallon; pale, $97\,^\circ99^\circ_{\odot}$, is. 3d. to is. 4d. per gallon; dark, $97\,^\circ99^\circ_{\odot}$, is. 2d. to is. 3d. per gallon; high boiling acid, is. 11d. to 2s. per gallon; all i.o.r. naked.

Carbolic Sixties.-Makers continue to store rather than sell at

Carbotle Sixtles.—Makers continue to store rather than sen at to-day's value of 1s. 1d. to 1s. 3d. per gallon.

Creosole Oil.—Fair business is being conducted in the best qualities. Specification oils, 2½d. to 3d. per gallon; gas works ordinary, 3½d. to 3½d. per gallon; washed oil, 3½d. to 3½d. per gallon; all ex works in bulk.

Coal Tar Pitch.—Home trade remains dull at 35s. to 37s. 6d. per

ton, f.o.r., but export price for forward delivery is firm at 40s. to

42s. 6d. per ton, f.o.b. Glasgow.

Blast Furnace Pitch.—Dull with controlled prices at 30s. per ton
f.o.r. works for home trade, and 35s. per ton f.a.s. Glasgow for

Refined Coal Tar.—Deliveries are proceeding quite rapidly, but price is easy at 2½d. to 2½d. per gallon, f.o.r. in buyers' packages. Blast Furnace Tar .- Remains without interest at 2 d. per gallon,

Crude Naphtha. - Supplies are not too plentiful, and value is about

**Water White Products.—Few orders are being placed. Motor benzol is about 1s. 4d. to 1s. 5d. per gallon; 90/160 solvent, 1s. 3d. to 1s. 4d. per gallon; 90/160 solvent, 1s. 3d. to 1s. 4d. per gallon; 90/160 heavy solvent, 1s. 1d. to 1s. 2d. per gallon; all in bulk, ex works.

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SEXTONE "B"

(METHYLCYCLOHEXANONE)

IMPROVED QUALITY

HIGHER EVAPORATION RATE

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IMPARTS VERY FINE GLOSS TO LACQUER FILMS

DOES NOT CAUSE DISCOLOURATION OF WHITE CELLULOSE ENAMELS

COMPETITIVE IN PRICE WITH THE OTHER PLASTICISERS ON THE MARKET

HOWARDS & SONS LTD. (Est. 1797), ILFORD, nr. LONDON

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing this firm's independent and impartial opinions.

Glasgow, June 23, 1931.

Business continues to be steady in the heavy chemical market. No outstanding items can be reported

Industrial Chemicals

ACETONE.-B.G.S.-£60 to £63 per ton, ex wharf, according to

quantity.

ACID, ACETIC.—Prices ruling are as follows: glacial, 98/100%, £47

to £58 per ton; pure, £37 5s. per ton; technical, 80%, £36 5s.,
delivered in minimum lots of 1 ton.

ACID, BORIC.—Granulated commercial, £22 per ton; crystals, £23

per ton; B.P. crystals, £31 per ton; B.P. powder, £32 per ton, in
1-cwt, bags, delivered Great Britain free in one-ton lots upwards,

Acid, Hydrochloric.—Usual steady demand. Arsenical quality, 4s. per carboy. Dearsenicated quality, 5s. per carboy, ex

works, full wagon loads.

ACID, NITRIC, 80° QUALITY.—£23 per ton, ex station, full truck loads.

ACID, OXALIC.—98/100%.—On offer at 3½d. per lb., ex store.

On offer from the Continent at 3½d. per lb., ex wharf.

ACID, TARTARIC, B.P. CRYSTALS.—Quoted is. per lb., less 5%, ex wharf.

On offer for prompt delivery from the Continent at 11½d. per lb., less 5%, ex wharf.

ALUMINA SULPHATE.—Quoted round about £8 10s. per ton, ex store.

ALUM, LUMP POTASH.—Now quoted £8 10s. per ton., c.i.f. U.K.,
ports. Crystal meal, about 2s. 6d. per ton less.

AMMONIA ANHYDROUS.—Quoted 10½d. per lb., containers extra and

returnable. Ammonia Carbonate.—Lump quality quoted £36 per ton. Powdered, £38 per ton. packed in 5 cwt. casks, delivered U.K. stations or f.o.b. U.K. ports.

Ammonia Liquin, 80°.—Unchanged at about 2½d. to 3d. per lb., delivered, according to quantity.

Ammonia Muriate.—Grey galvanisers' crystals of British manufacture quoted £21 to £22 per ton, ex station. Fine white crystals offered from the Continent at about £17 5s. per ton, c.i.f. U.K. ports.

ANTIMONY OXIDE.—Spot material obtainable at round about £24 per ton, ex wharf. On offer for shipment from China at about 22 per ton, c.i.f. U.K.

ARSENIC, WHITE POWDERED.—Quoted £22 10s. per ton, ex wharf
Spot material still on offer at £22 15s. per ton, ex store.

BARIUM CHLORIDE.—In good demand and price about £9 10s. per
ton, c.i.f. U.K. ports. For Continental materials our price
would be £8 10s. per ton, f.o.b. Antwerp or Rotterdam.

BLEACHING POWDER.—British manufacturers' contract price to

consumers unchanged at £6 15s. per ton, delivered in minimum 4-ton lots. Continental now offered at about the same figure.

CALCIUM CHLORIDE.—Remains unchanged. British manufacturers' price, £4 15s. to £5 5s. per ton, according to quantity and point of delivery. Continental material on offer at £4 7s. 6d. per ton,

of delivery. Continental material on offer at £47s. 6d. per ton, c.i.f. U.K. ports.

Copperas, Green.—At about £3 15s. per ton, f.o.r. works, or £4 12s. 6d. per ton, f.o.b. U.K. ports.

Formaldehybe, 40%.—Now quoted £29 per ton, ex store. Continental on offer at about £27 per ton, ex wharf.

Glauber Salts.—English material quoted £4 10s. per ton, ex station. Continental on offer at about £3 per ton, ex wharf.

Lead, Red.—Price now £30 per ton, delivered buyers' works.

Lead, White.—Quoted £38 per ton, carriage paid.

Lead Acetate.—White crystals quoted round about £32 to £34 per ton c.i.f. U.K. ports. Brown on offer at about £1 per ton less.

Magnesite, Ground Calcined.—Quoted £9 10s. per ton, ex store.

Methylated Spirit.—Industrial quality 64 o.p. quoted 1s. 8d. per gallon, less 2½% delivered.

Potassium Bichromate.—Quoted 4£d. per lb., delivered U.K. or

POTASSIUM BICHROMATE.—Quoted 41d. per lb., delivered U.K. or c.i.f. Irish ports, with an allowance for contracts.

Potassium Carbonate.—Spot material on offer, £25 ios. per ton ex store. Offered from the Continent at £24 i5s. per ton, c.i.f. U.K. ports.
Potassium Chlorate, 991/100% Powder.—Quoted £26 15s. per

ton ex store; crystals 30s. per ton extra.

Porassium Nitraate.— Refined granulated quality quoted £20 17s. 6d. per ton, c.i.f. U.K. ports. Spot material on offer at about £20 10s. per ton ex store.

POTASSIUM PERMANGANATE B.P. CRYSTALS.—Quoted 51d. per lb., ex wharf.

ex wharf.

Potassium Prussiate (Yellow).—Spot material quoted 7d. per lb. ex store. Offered for prompt delivery from the Continent at about 6\frac{3}{4}d. per lb. ex wharf

SodaCaustic.—Powdered 98/99%, £17 10s. per ton in drums, £18 15s. in casks. Solid 76/77% £14 10s. per ton in drums, £14 12s. 6d. per ton for 70/72% in drums; all carriage paid buyer's station, minimum four-ton lots; for contracts 10s. per ton less.

SODIUM BICARBONATE.—Refined recrystallised, £10 10s. per ton,

ex quay or station. M.W. quality 30s. per ton less.

SODIUM BICHROMATE.—Quoted 3\frac{1}{2}d. per lb., delivered buyer's premises, with concession for contracts.

SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station; powdered or pea quality, 7s. 6d. per ton extra. Light soda ash, £7 13s. per ton, ex quay, minimum four-ton lots, with various reductions for contracts.

SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £9 2s. 6d. per ton, ex station, minimum four-ton lots. Pea crystals on offer at £15 per ton, ex station, minimum four-

ton lots. Sodium Nitrate. -Chilean producers now offer at fro per ton,

SODIUM NITRATE.—Chilean producers now offer at £10 per ton, carriage paid, buyer's sidings, minimum six-ton lots.

SODIUM PRUSSIATE.—Quoted 5\frac{1}{2}d. per lb., ex store. On offer at 5d. per lb., ex wharf, to come forward.

SODIUM SULPHATE (SALTCAKE).—Price, 6os. per ton, ex works; 65s. per ton, delivered, for unground quality. Ground quality 2s. 6d. per ton extra.

SODIUM SULPHIDE.—Prices for home consumption: solid 61/62%, £10 per ton; broken, 60/62%, £11 per ton; crystals 30/32%, £8 2s. 6d. per ton, delivered buyers' works on contract, minimum four-ton lots. Special prices for some consumers. Spot material 5s. per ton extra.

SULPHUR.—Flowers, £12 per ton; roll, £10 10s. per ton; rock, £9 5s. per ton; ground American, £8 10s. per ton, ex store.

ZINC CHLORIDE 98%.—British material now offered at round about £18 10s. per ton, f.o.b. U.K. ports.

ZINC SULPHATE.—Quoted £11 per ton, ex wharf.

ZINC SULPHATE.—Quoted £11 per ton, ex wharf.

Note.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

The Leaching of Copper Ores Factors Controlling Speed of Process

FACTORS involved in the heap leaching of copper ores are discussed in *Information Circular* 6425, which has just been issued by the United States Bureau of Mines. This circular presents a résumé of the results obtained in heap leaching studies at the South-West Experiment Station, Tucson, Arizona, where the author (Mr. John D. Sullivan) is associate metallurgical chemist.

The conclusions drawn are that (a) ingress of solutions, (b) dissolution of minerals, and (c) removal of the soluble copper are interdependent factors in the leaching process, which work simultaneously. Frequent renewals of solution and considerable time is required to get sufficient solvent into contact with the minerals and to wash out the dissolved If the copper exists as sulphide (chalcopyrite excepted), about 20 days will be required for complete dissolution of the copper, granting contact of mineral and solvent solution during the entire period. The rate of dissolution of copper minerals is a chemical factor, and in heap leaching practice, for a given solvent, the rate can not be markedly changed. Although the rate of dissolution increases with increases in temperature, it is difficult to control temperature in a large heap. Actual temperature measurements within the heaps usually indicate a higher temperature than that of the outside air, which shows that the heat from chemical reactions is fairly well stored within the heap. It may therefore be possible to increase gradually the temperature within the heaps by adding warm solution.

Waste smelter gases, if available, might be used with a heap leaching plant. If waste gases are allowed to enter heaps and displace the air present, before water is added, to a given section of the heap, the solutions should penetrate more rapidly into the interior of the rocks. Waste gases would also add a reagent that would help to dissolve the copper minerals present.

From a practical standpoint, the method of speeding up the rate of extraction is to crush the ores finer. Crushing the ore particles would not only decrease the time required for saturation, but it would also make the ore more amenable to leaching by open cleavage planes and crevices in the ore particles and by shortening the path required for the leaching solutions to come into contact with the mineral particles, and for the dissolved copper to be brought to the surface. Crushing to a smaller size than 2 or 3 inches produces too much "fines, which tends to counteract the advantages of crushing.

VITREOSIL CONTAINERS



Be sure to visit our Stand at the British Chemical Plant Exhibition, Central Hall, Westminster, London, S.W.I, July 13—18, 1931, and see our latest introductions in VITREOSIL plants for the Manufacture of Hydrochloric and other Acids and Chemicals.



In support of the JUBILEE CELEBRATION 13/20 July, 1931

THE THERMAL SYNDICATE LTD.

VITREOSIL WORKS, WALLSEND-ON-TYNE

LONDON DEPOT: THERMAL HOUSE, OLD PYE STREET, S.W. I

Manchester Chemical Market

(FROM OUR OWN CORRESPONDENT.)

Manchester, June 25, 1931.

There is no striking change in the general position of the chemical market here. For the most part, so far as new business is concerned, current sales are of moderate sized quantities, with occasional fair parcels being disposed of. On the whole, however, deliveries against old contract commitments keep up a fair level. Apart from the few instances where some degree of weakness is still in evidence, the market maintains a reasonably steady tone. The war debt proposals emanating from the United States, without having any actual influence on the market, served to create a more cheerful air.

Heavy Chemicals

A moderate demand is reported for bicarbonate of soda, values of which keep firm at round £10 10s. per ton. Diphosphate of soda is the subject of a small scale inquiry, but there has been no further change in prices, current offer being at about £10 per ton. Saltcake is a fairly active section of the market and quotations are steady at from £2 15s. to £3 per ton. The call for caustic soda against old contracts is not unsatisfactory, prices for these ranging from £12 15s. to £14 per ton. There is a moderate inquiry about for prussiate of soda, offers of which are firm at from £2d. to 5½d. per lb., according to quantity. Sales of hyposulphite of soda this week have been of moderate extent and values are steady at round £9 per ton for the commercial grade and £15 5s. for the photographic material. Only a quiet trade is passing in the case of chlorate of soda, quotations for which are in the neighbourhood of £26 10s. per ton. Sulphide of sodium is also on the quiet side, but there has been little further alteration in prices, the 60-65 per cent. concentrated solid quality being on offer at up to £9 per ton and the commercial material at about £7 15s. Alkali meets with a quietly steady demand at round £6 per ton. With regard to bichromate of soda, there is a moderate movement in this section on the basis of ½d. per lb., less 1 to 2½ per cent., according to quantity.

Yellow prussiate of potash is steady and in moderate inquiry

Yellow prussiate of potash is steady and in moderate inquiry at from $6\frac{1}{4}$ d. to $7\frac{1}{4}$ d. per lb., according to quantity. Buying interest in the case of chlorate of potash is on quiet lines at the moment, with prices at about £27 10s. per ton. Bichromate of potash is well held on the basis of $4\frac{1}{4}$ d. per lb., less 1 to $2\frac{1}{2}$ per cent., and a fair demand has been reported this week. The tendency of caustic potash is somewhat easy and down to £27 10s. per ton has been mentioned during the past week, with the demand only moderately active. Carbonate of potash meets with a quiet demand but values are much the same as at last report, offers being at round £24 10s. per ton. Permanganate of potash is quoted at round 5d. per lb. for the commercial grade and $5\frac{1}{4}$ d. to $5\frac{1}{2}$ d. for the B.P.

Arsenic is steady with the demand on moderate lines, about £19 10s. per ton, at the mines, being quoted for white powdered, Cornish makes. Sulphate of copper is uncertain still and at about £18 10s. per ton, £0.b., the demand has been quiet. No further actual weakness has developed in the acetates of lime, the grey being quoted at £12 5s. per ton and the brown at £7 5s. The lead compounds are maintained at £32 and £31 per ton for the white and brown acetates, and from £28 10s. to £29 for nitrate, sales being of limited extent.

Acids and Tar Products

A moderate movement of oxalic acid is reported at about £1 1.4s. per cwt., ex store. Acetic acid is firm and in fair inquiry at about £37 per ton for the 80 per cent. commercial quality and £51 per ton for the technical glacial. Tartaric acid meets with a quiet demand and prices seem steady at the moment at round 11½d. per lb. Citric acid is on offer at from 11¾d. to 1s. per lb.

Among the by-products, pitch is steady at from 37s. 6d. to 40s. per ton, f.o.b., and a certain amount of forward inquiry is reported. Creosote oil is inactive still, but prices are unchanged at from 3d. to 3\frac{3}{4}d. per gallon, naked. Trade in carbolic acid is rather slow, with crystals quoted at about 5\frac{1}{4}d. per lb., and crude 6o's at 1s. 2d. per gallon, naked. There is not much doing in the case of solvent naphtha, which is quoted at from 1s. 1\frac{1}{2}d. to 1s. 2d. per gallon.

Company News

Pease and Partners.—Report for year to March 31, 1931, shows loss, after providing for bad debts, maintenance of collieries, etc., and other works standing idle, of £134,584, plus Debenture interest, etc., £84,493, and depreciation of plant, £57,545, making total loss of £276,622 (against loss £95,148).

ATTOCK OIL Co.—Reports that for 1930, there was a profit, before depreciation, of £70,210, against £367,006 in 1929. Depreciation this time absorbed £100,000—against twice as much last time—so that there is a loss for 1930 of £29,789. The credit brought in was £196,851 and as no dividends are proposed, the credit balance of £167,061 is carried forward.

The credit brought in was £196.851 and as no dividends are proposed, the credit balance of £167,061 is carried forward.

Franco-British Oil Trust.—Report for 1930 states that company has acquired lease of Wardend Colliery, which contains cannel coal of good analysis. Owing to considerable delay on part of contractors and others, first unit of plant erected at Belvedere, Kent, by Parent Coal Carbonisation Trust has only recently come into operation. Accounts show administrative expenses increased by £3,089, to £37,869.

ABERTHAW AND BRISTOL CHANNEL PORTLAND CEMENT.—

ABERTHAW AND BRISTOL CHANNEL PORTLAND CEMENT.— Trading profit, including interest and surplus taxation provision, £60,705 (against £66,30), making available £146,332. After deducting Debenture interest, directors' fees, Preference dividend and £4,051 Debenture stock sinking fund and £15,000 for depreciation, final dividend on Ordinary shares of 3 per cent. is recommended, making 6 per cent., less tax, for year (8½ per cent.), carrying forward £77,082 (£76,627).

ELECTRIC FURNACE COMPANY, LTD.—The report of the

ELECTRIC FURNACE COMPANY, LTD.—The report of the directors for the year ended March 31 shows a net profit for the year of £4,400, which, with £3,092 brought forward from last year, makes the total available profit £7,492. An interim dividend of 3½ per cent. on the Cumulative Preferred Ordinary Shares, amounting to £2,800, having already been paid, the directors recommend a final dividend of 3½ per cent. on the Preferred Ordinary shares, absorbing £2,800, leaving £1,892 to be carried forward.

New Companies Registered

BLEACHING PATENT PROCESSES, LTD., 30, St. Ann Street, Manchester. Registered June 22. Capital, £5,000 in 4,940 10 per cent. cumulative participating preferred ordinary shares of £1 and £1,200 founders' shares of 1s. each. To adopt an agreement with A. S. Kilpatrick and the East Lancashire Chemical Co., Ltd., and to acquire the bleaching, scouring and filling processes as applicable to the textile trades. Directors: J. F. W. Stuart, T. C. Redfern, T. W. Holt, A. S. Kilpatrick

Kilpatrick.
INDUSTRIAL AND CHEMICAL ENGINEERING CO., LTD., 33, St. Stephen's House, Westminster, S.W.I. Registered June 17. Capital, £100 in 18. shares. Engineers, manufacturers, agents, merchants and warehousemen, dealers in industrial and chemical plant, engineering materials and chemicals, etc. Directors: F. T. Jenkins, C. L. Gray.

in industrial and chemical plant, engineering materials and chemicals, etc. Directors: F. T. Jenkins, C. L. Gray.

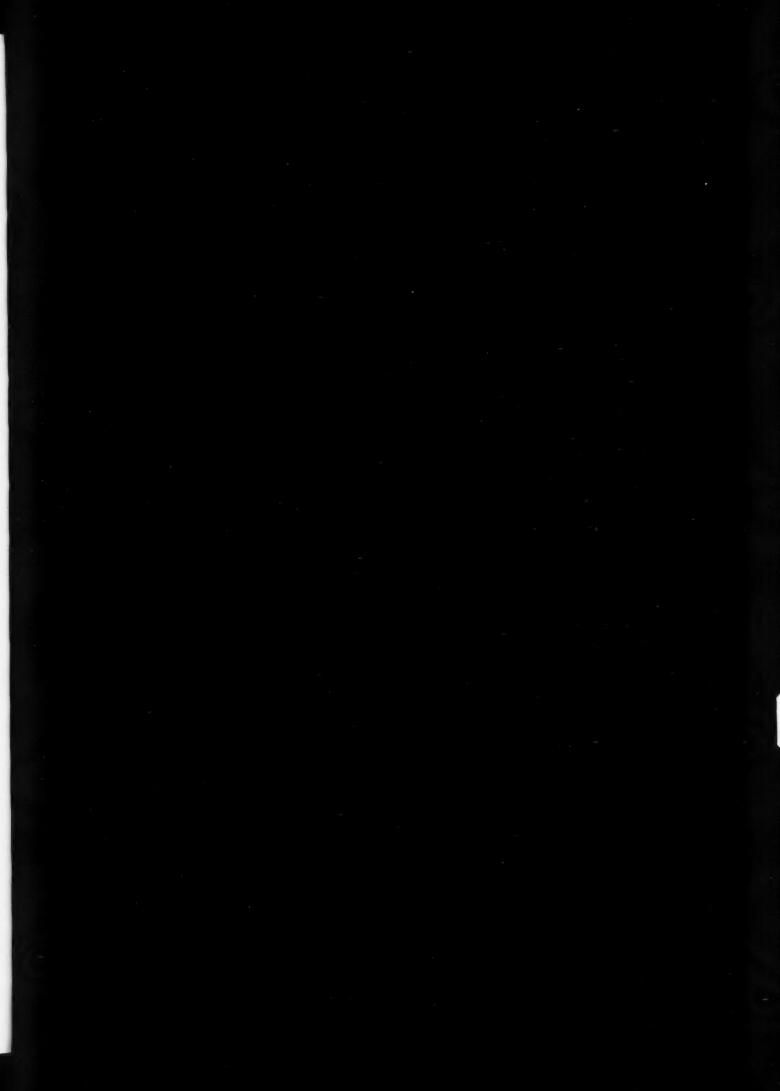
MURPHY CHEMICAL CO., LTD., 11, Meetinghouse Lane, Sheffield. Registered June 19. Capital, £33,000 in 30,000 f per cent. cumulative preference shares of £1, and 60,000 ordinary shares of 1s. each. Manufacturers of and dealers in antiseptics, disinfectants, detergents, fertilisers, insecticides, fungicides, animal medicines, powders, condiments, meals and animal feeding stuffs, etc. Directors: A. J. Murphy, J. S. Mitchell, Col. M. C. Clayton, F. A. Mason, H. M. White.

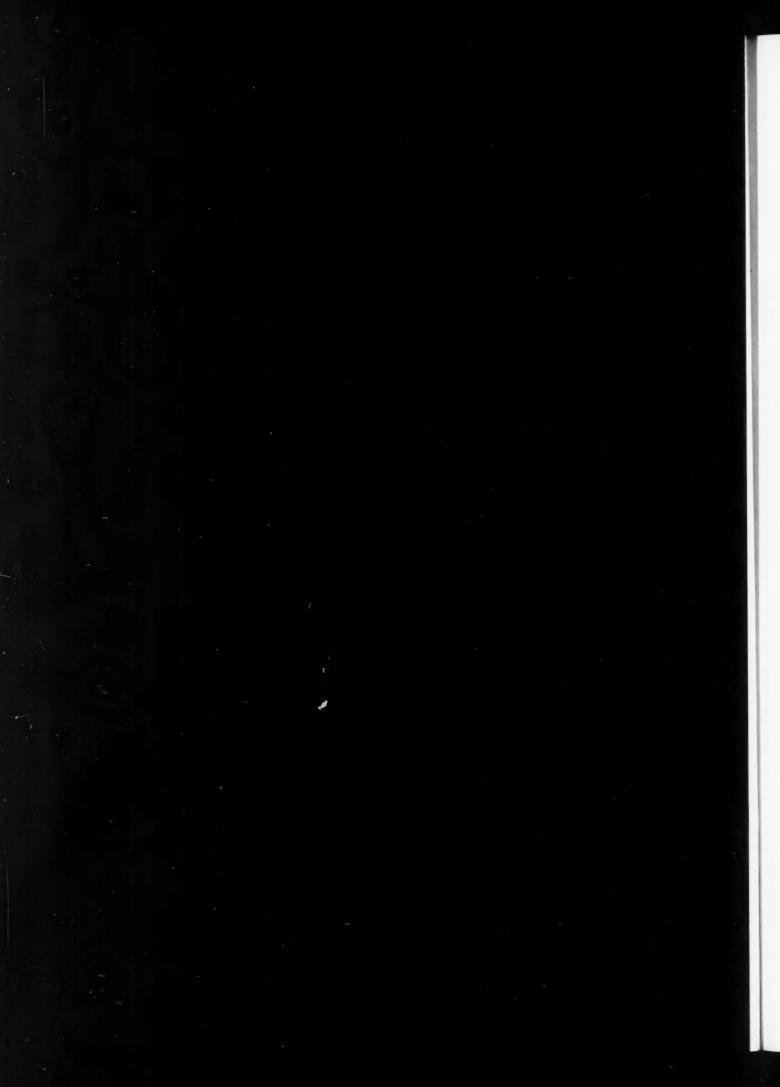
TURNOVER FILTER CO., LTD., 101, Bridge End,

TURNOVER FILTER CO., LTD., 101, Bridge End, Belfast. Registered June 1, 1931, in Belfast. Nominal capital £2,000 in £1 shares. Manufacturers of filters and filtering plant, installers of water purifying plants; engineers, etc. Directors: B. Bramwell, C. B. Bramwell, F. W. Bramwell, John B. Bramwell, T. Bramwell.

Tariff Changes

AUSTRALIA.—Tung oil has now been added to Appendix D, which comprises materials regarded as "raw materials." Ethylene glycol, when imported by manufacturers of antifreezing compounds to be used exclusively in the manufacture of such compounds, in their own factories, is now free of import duty in all tariffs, whereas the former duty in the British Preferential Tariff was 15 per cent. ad val. and in the General Tariff was 17½ per cent. ad val.





Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

The Dyestuffs Controversy

The controversy over the continuance or discontinuance of the Dyestuffs Act, vigorous as it was while it lasted, very quickly ended with the final decision of the House of Commons to extend the measure for another twelve months. Had there been any really widespread or deep rooted grievance, the Commons decision should have produced a crop of vigorous protests, but there has been nothing resembling this, and the only people offended are the representatives of the Government whose pontifical rulings were upset by the House. One case in particular has attracted attention—the case of Major A. G. Church, M.P., Parliamentary Secretary to the Minister for War, who voted against his own Minister, and whose resignation is now announced. An important member of the Cabinet like the Rt. Hon. Tom Shaw cannot, of course, have his own Parliamentary Secretary speaking and even voting against his own policy, and the latter's resignation is in accord with Parliamentary etiquette. But Major Church's courageous action will be cordially applauded not only as a piece of political honesty but as indicating the feeling of the scientific community towards the Government's attitude.

The Future

While no one now troubles very much about the Act, it is to be hoped that matters will not be allowed to drift, as they have done in the past few months, until a similar situation arises at the end of a year. At the end of 1931 the present Government may or may not be in office. If they are not, then the control of policy will have passed to a Government openly pledged to protection in a very definite form. What people interested desire is that a question like the dyestuffs industry should not be decided from the standpoint either of the irreconcilable freeimports party or of the equally partisan protectionist party but should be considered carefully in relation to industrial, scientific and national interests. That can only be done by a joint conference of all the sections concerned, and everyone will hope that early steps may be taken to bring the chief parties together and to induce them, if possible, to reach an agreed settlement. ever party happened to be in power, they would have to listen to united recommendations from the industry itself. In the absence of such recommendations, the question will become a mere political shuttlecock and will be decided by regimented politicians instead of by people who understand and are commercially interested in the industry.

Outside Opinion

When the President of the Board of Trade first announced that the Government intended to allow the Dyestuffs Act to lapse, the news produced a little excitement abroad and led to some decidedly premature conclusions. There was said to be "jubilation" in Germany, "satisfaction" in Switzerland, while from the American group of dyestuff producers came few expressions of either sorrow or joy, although the United States is next to Germany, and perhaps Switzerland, Great Britain's most formidable competitor in the export market. Some of the American journals compare the growth of both the American and the British dyestuffs industry under different forms of protection, and

the announcement that the Dyestuffs Act was to end left them wondering as to our different mentality on such matters and speculating as to the effects.

I.C.I. Message to Users

The note on "service" to British colour users, issued by Imperial Chemical Industries, Ltd., emphasises an aspect which the German dyestuff manufacturers paid great attention to but in which, until recently, British producers were thought to be a little lax. "The aim," the I.C.I. message states, "of the British dyestuffs industry has always been to give unexcelled service in every direction. Men, already highly qualified, have been carefully trained in the many problems arising during the application of dyestuffs. Their assistance has meant the solution of thousands of difficulties and their advice is continually sought. In some of the finest industrial laboratories to be found, British chemists are working to-day, as they have been for many years past, on problems that one by one are being solved and one by one add to the advantages which the user receives by way of new colours, better colours and colours at lower prices. Throughout the country, sales offices have been established to give quick delivery of the dyer's requirements and to ensure that men are on the spot to give personal service. This comprehensive organisation is at the service of the colour user and it has been built up with the help of the present Act. The makers have expressed their willingness to accept a modification of the present Act so that prohibition of dyestuff imports will only apoly when there is a British equivalent at an equal By acceptance of this offer, no financial burden would be imposed on the colour user and the development of the dyestuffs industry, so essential on national and economic grounds, would be enabled to continue.

New Wetting Out Agent

The Dyestuff Department of E. I. du Pont de Nemours and Co. announces Alkanol, a new wetting out and dispersing agent. It is said to act on cotton fibres in all forms to render them easier to penetrate by the solutions used in processing, dyeing and printing. Owing to its softening properties, it aids in removing impurities such as burrs, waxes, etc., speeds up the boiling out process and is very valuable in kier boiling.

Dyestuffs Licences for December

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during December, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 592, of which 539 were from merchants or importers. To these should be added 16 cases outstanding on November 29, 1930, making a total for the month of 608. These were dealt with as follows: Granted, 572 (of which 557 were dealt with within seven days of receipt); referred to British makers of similar products, 23 (of which 20 were dealt with within seven days of receipt): outstanding on December 31, 13. Of the total of 608 applications received, 577, or 95 per cent., were dealt with within seven days of receipt.

British Dyestuffs Progress in 1930

By L. J. Hooley

THE certainty that the Act is to be renewed for another year provides a very satisfactory finish to the old year and a hopeful encouragement for the new. There can be little doubt that the decision is a right one from all points of view. We will not make any attempt to summarise the controversy, and in fact, with the attainment of the immediate objective, the arguments have suddenly lost their interest. They have lost them at any rate for the time being, and although they They have may need to be resuscitated later they could be forgotten quite happily during the holidays.

If the decision to renew was only reached after more trouble than should have been necessary, this has, perhaps, had the advantage of bringing the importance of the industry back into the public eye with all the publicity attendant on an important and interesting political issue. It has been imsible to follow the political discussions without realising what false impressions are held, and often sincerely held, on various aspects of the dyestuffs question. And perhaps the industry itself is partly to blame for allowing these misapprehensions to remain.

This protection question has rather monopolised attention to the exclusion of the usual interest in the year's work, but the outstanding features can be briefly given. Behind the natural preoccupation with the Act internal development has been going on as usual, except that there has been an added determination to make the best use of the year.

Looking at the past year broadly, it may first be said that although trade conditions have been adverse the British dyestuff industry has hardly suffered as much as might have been expected. Commercially, progress has not been as good as in the last two or three years, but all the same it has been considerable. The usual annual statistics are not available, so that an accurate estimate is not possible for the present. On the technical side matters have proceeded much as usual, and before going any further it will be convenient to review the more important advances in each branch made by the dyestuff industry, British and foreign.

Intermediates

The number of patents in intermediates of direct or possible interest for dyes has again been very large, approaching the number dealing with dves themselves. They range from attempts to make organic intermediates directly from primary fuels to the synthesis of complex intermediates for particular colours. Processes such as hydrogenation, dehydrogenation, oxidation and cracking are being very widely examined, special attention being given to choice and preparation of catalysts and conditions of control in order to get individual products. The manufacture of methyl alcohol from carbon monoxide and hydrogen is an important branch of this and attempts are made to find modifications which will give higher alcohols.

New details are given for the production of olefines, for the eparation of the various isomers, and for their conversion to aldehydes. The control of the production of bases from acetylene and ammonia is becoming better understood and the condensation can be controlled in one direction to give a 75 per cent. of acetonitrile and in another to give an equal yield of pyridine bases.

Professor G. T. Morgan has given an interesting review of the many condensations in which formaldehyde can play a part. Ketone is obtained in 80 per cent, yield from acetone at 650-700° in a catalyst chamber composed entirely of copper. The number of patents which still appear for the recovery of acetic acid suggest that a satisfactory process is still to be found. Phenols, acid chlorides, amines, aminoalcohols, unsaturated aldehydes and ketones all receive attention, and a large part of this work is also carried out in the vapour phase. These gaseous reactions extend also to the aromatic series, and examples include the reduction of phenols to hydrocarbons and the conversion of p-cymene to a mixture of toluene and propylene by passing over an activated bleaching earth.

The synthesis of naphthoquinone and anthraquinone derivatives from ay-butadiene and benzoquinone and similar substances is being exploited in the patent field. Several methods have been evolved recently of making benzoic acid

from phthalic anhydride, and attention is directed at the moment to purification of the acid obtained.

In recent years many new highly substituted anilines and other benzene derivatives have been prepared as intermediates for ice colours, triphenylmethane and indigoid dyes; this substitut on increasing fastness and brightness in many cases. This tendency has not been so apparent during the past year, probably because of the increasing difficulty of finding new derivatives which can be easily prepared.

Azo Colours

The azo field still shows its remarkable fertility, and more work has appeared on these colours than any others. a variety of fluorine compounds have been brought into use for stabilising diazonium salts. Whether the appearance of these and other methods of stabilisation means that the products on the market are not satisfactory is not yet clear

New selections of bases and arylides have been brought out in the Naphthol AS series, and while speaking of these a reference may be made to the very interesting High Court action which was decided early in the year, in which Imperial Chemical Industries successfully applied for revocation of three patents of the I.G. Farbenindustrie A.-G., which were considered to be unjustifiable selections from the field of the expired main Naphthol AS patent and which were considered to be prolonging the monopoly in certain directions. revocation was primarily of benefit to the colour using interests because it removed for them any restrictions on the products with which the patents in question were concerned. The result is of interest as showing the ability of the British dyestuffs industry to hold its own in the legal as well as the scientific field. Mr. Justice Maugham in his decision laid down some of the conditions which he considered must govern decision as to the validity of selection patents.

A very interesting point to be noticed is the announcement of the first green monoazo dye, this being included among the products obtained by coupling a 6-amino, 6-arylamino or 6-aralkylamino-2: 3-hydroxynaphthoic acid arylide with a diazotised amine in the usual way. In addition to many miscellaneous patents for acid and chrome azo dyes, attention is still being directed to those in which the chromium or other metal is incorporated with the dyestuff before marketing. Several variations in the technique of synthesising these have been described. Imperial Chemical Industries have again taken out a large number of patents describing substantive dyes for viscose silk, and this special branch is now attracting more attention abroad.

Triarylmethane and Basic Colours

Amines obtained by the action of phenylethyl halides on arylamines are converted to triphenylmethane Phosphotungstic and similar complex basic pigments have been prepared starting from the leuco bodies. chromed triarylmethane dyes are combined with prechromed azo dyes to give shades of unexpected fastness. A few new patents dealing with dyes of the astrophoxine type have also appeared. Naphthalic anhydride and its derivatives form one of the outstanding additions to the field of dyestuff inter-mediates, being recommended for acid colours, acetyl silk colours, for coupling with azo bodies and in the vat field.

Sulphur Colours

Several new sulphur dyes giving shades of orange, red, . violet and green have been synthesised, these being the colours most wanted. Molybdenum has been suggested for addition to sulphur melts, and cyclohexanol is stated to be a good solvent for the same purpose.

For the time being the thioindigoid dyes have almost ousted indigoid dyes from the research field. Interest centres chiefly in the selection of new isomers and in the production of the necessary thioglycollic acids and other intermediates. A new method of making water-soluble products is by condensing mchlorosulphonylbenzoic acid with an NH-group in indigo. The products are hydrolysed by alkali.

Anthraquinone Derivatives

This is the field which shows most fundamental new work, and side by side with the discovery of new carbo-cyclic and heterocyclic ring systems there proceeds the preparation of new substituted derivatives from the old. It is possible to trace the general course of development which follows the discovery of any new dye nucleus. Fuller details of these advances will be found in the next issue.

Advances such as have been described above are of immediate interest to the manufacturer only, and the next two or three years will show which of these are likely to be important. Of more direct interest to the user are the discoveries of recent years which have now reached the selling stage.

The output in Great Britain in this direction during the past year was very good indeed, the following being among some

Navy Blue B.
Light Green B.
Dark Green B.
Black DB.

,, Bordeaux B., Orange G.
Caledon Claret BS paste.
,, Dark Blue WFS.

Orange 3RS.
Orange 5RS.
Red 3GNS.

Chlorazol Black JHS.

Brown A.

Fast Blue FFKS.
Fast Scarlet 4BAS.
Union Navy Blue 2B.
Union Black SB.
Yellow 8GS.

Coomassie Brilliant Blue FFS.
.. Yellow OS.

,. Yellow RS. Dispersol Fast Orange BS paste. Duranol Green GS.

,, Violet RS. Durindone Pink FFS.

Erythrosine FS.
Lissamine Fast Navy 2G.

... Violet 6BNS.

Monolite Fast Red GS Paste and Lumps.

Yellow TS Powder.

Naphthalene Scarlet BS. Oil Yellow ATS.

Rhodamine BS. Solazol Red 2B.

Solochrome Black RN.

Green VS.
Red 6BS.
Yellow 3GS

Thionol Indigo Blue 2RS.
Sky Blue 6BS.

The Altex colours are a new series brought out by Imperial Chemical Industries for dyeing acetyl silk in union with other fibres and represent another addition to the outstanding services which the British industry has rendered to the dyers and users of artificial silks. Solazol Red 2B is also the first of a new series. The idea of this series is to provide a direct process of applying certain of the fast colours which have previously had to be synthesised on the fibre.

The Dyestuffs Group of Imperial Chemical Industries includes in its activities other branches, such as rubber products, synthetic resins and moulding powders, and textile assistants, and among the year's advances mention may be made of a new phenol-formaldehyde moulding powder and a

new flexible lacquer. The former is stated to show a distinct advance on powders of this type previously available, while the lacquers combine remarkable flexibility and adhesive capacity for rubber surfaces, and are free from drying oils and show superiority in ageing and weathering properties.

Production Figures

As has already been stated the total production figures for last year are not yet available, and the year was not a favourable one for improving on previous records. The previous year's annual report showed the remarkable progress which had been made during the three preceding years in increasing total production and increasing exports. Since that report the corresponding figures for 1929 have now become available, and although they have been quoted fairly often recently they are given again because they show so well the progress which has been made under existing conditions:—

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1926																		30,297,000	
1927											è	*				*		39,551,756	
1928		,																50,960,472	
1929		,																55.785,032	
]	E	X		99	0	R	T	S							Lbs.	
1926																		6,014,288	
1927			. ,								,							7,600,208	
1928									,		è							10,378,592	
1929																		15,244,544	

During last year further efforts were made to increase the export trade, in spite of the difficult political situations in India and elsewhere.

This year promises to be full of interest and possibly difficulties, but for the moment it is very satisfactory to feel that there is a year ahead in which the great progress of the last few years is not to be interrupted.

German Dye Trust and Mont-Cenis Plant

Instead of purchasing the Mont-Cenis nitrogen plants in the Ruhr district, as previously reported, the German dye trust is said to have acquired them on a lease basis, apparently exercising an optional right accorded at the original deal made last July. This resulted in the signing of a new option contract on October 23, 1930, according to the Berliner-Boersen-Courier. The German dye trust continues to operate the Mont-Cenis plants and is not expected to close them. They are set up for the production of an ammonium sulphatenitrate, the so-called "Montansalpeter," which to all appearances and analysis is the same as the dye trust's "Leunasalpeter" with 26 per cent. nitrogen, one-fourth as nitrate nitrogen and three-fourths ammonia nitrogen.—U.S. Trade Commissioner William T. Daugherty, Berlin.

Decrease in Japanese Dyestuffs Imports

A SLUMP in Japanese imports of dyestuffs is dealt with in a note from the U.S. Consul at Kobe. Imports at Kobe and Osaka during the first nine months of 1930, according to statistics furnished by the Imperial Japanese Customs, amounted to 1,661,000 pounds, a decrease of 55 per cent. in volume, when compared with the imports during the same period of 1929. This slump has been brought about by the decreased production of the Japanese cotton, woollen, and silk textile trades, all of which have been operating on a reduced schedule. Local dyestuff importers state that unless new orders are obtained by the mills the dyestuffs trade will be seriously affected.

Foyle's Technical Catalogue

W. AND G. FOYLE, LTD., the well-known booksellers, of 119-125, Charing Cross Road, London, now claim to hold the largest stock of new and second-hand technical books in the world and their new catalogue includes books on over 450 subjects (there is an unfortunate misprint on the cover stating the number as only 200). All are carefully classified, and the catalogue is undoubtedly one of the most comprehensive guides to English and American technical works, Chemistry, in its various branches, is well represented among the headings, and some of the most recent publications are listed at greatly reduced prices.

Current Researches on Dyes and Textiles

Notes on Recent Progress

Mordanting of cellulose acetate rayon.—Up to the present time it has proved difficult to fix metallic residues within cellulose acetate rayon for weighting or mordanting purposes The difficulty is due to the lack of affinity of this type of rayon for any inorganic salt, and furthermore to its much smaller absorptive capacity (as compared with viscose rayon) for aqueous liquors. A method (E.P. 336,621) for securing satisactory mordanting with iron, tin, aluminium, and chromium salts has been devised in which one of the ingredients involved is added to the spinning solution so that the rayon produced can afterwards be further treated in a simple manner so as to fix the first ingredient.

In the case of an iron residue, cellulose acetate rayon is first spun from an acetone solution of cellulose acetate containing nearly I per cent. of ferric thiocyanate by the dry process, and the resulting rayon, in any convenient form, is then treated in a warm bath of sodium carbonate so that ferric hydroxide is fixed within the individual threads. This rayon may then be dyed with mordant dyes

When the metallic residue is employed for the purpose of weighting it is advisable to add to the spinning solution as much as 15 to 20 per cent. of a salt such as stannic thiocyanate or chloride, and then aftertreat the rayon with sodium phosphate or other fixing agent. If the spinning is carried out by a wet process instead of the more usual dry method then it is possible to add the fixing agent to the coagulating liquor into which the rayon is spun.

Mercerised Cotton

Improved test for mercerised cotton.-For many years the Huebner's iodine test for mercerised cotton has proved very useful. In carrying out this test the cotton material is immersed for a few minutes in a concentrated solution of iodine in potassium iodide solution and then washed with mercerised cotton retains the absorbed iodine much more strongly than non-mercerised cotton so that after sufficient washing the mercerised cotton remains a deep blue colour (due to presence of iodine) whilst the non-mercerised cotton becomes pale grey. By this means it is also possible to obtain an idea as to the degree of mercerisation since the persistence of the blue colour is greater the more thorough the mercerising process

It is obvious that the above method does not allow permanent records of the test to be kept since the blue colour due to the presence of iodine is unstable. For this reason it is particularly useful to be able to take advantage of a novel modification of the method as described by Ermen (Text. Manuf. 1930, **56**, 414). In this modification use is made of the fact that a mixture of alpha-naphthol and dimethyl paraphenylene diamine is readily oxidised in alkaline solution to a stable blue pigment.

Ermen's method thus consists of immersing the cottons to be examined in a solution (saturated with potassium iodide) containing 40 per cent. of iodine, then thoroughly washing with water, and further immersing for a few seconds in a mixture of equal volumes of the following two solutions:

Solution 4

Dimethyl paraphenylene diamine sulphate	18 grams.
Sodium sulphite crystals	100 grams.
Volume	1,000 c.c.
Solution B.	
Alpha-naphthol	15 grams.
Caustic soda 70 Tw	22 C.C.
Volume	T 000 C C

The well mercerised cotton thus becomes permanently stained a deep blue, and the intensity of this blue is proportional to the degree of mercerisation.

Solution A will keep unchanged for some months in a well stoppered bottle, but solution B is not stable more than a few weeks and must be discarded when it begins to turn

Dye Intermediates

New titration methods for dye intermediates.—The salts of sulphonic acids of β-naphthol, particularly Crocein, Schæffer, R-, and G-acids, find an important use in the manufacture of such dyestuffs as Crocein Orange, Ponceau 2G, and Crystal

R- and G-acids are formed by further sulphonation of Schæffer's acid, and since it is not possible to avoid forma-tion of a mixture of these compounds in the sulphonation process it is valuable to have available an accurate method for determining the relative amounts of each acid in the mixtures produced. Two recent papers* by S. D. Forrester and D. Bain describe such methods and are thus important.

The usual method for estimating such sulphonic acid makes use of their property to absorb bromine from a standard solution of substances capable of liberating bromine. Schæffer and R-acids, by the 'method of Vaubel, † quantitatively combine with one molecule of bromine (from an acidified solution of potassium bromide and bromate). But under such conditions G-acid absorbs much less than the theoretical amount. The methods of Forrester and Bain have been devised to overcome these difficulties and they utilise the fact that the absorption of bromine by such β-naphthol sulphonic acids can be considerably modified by the conditions prevailing during the bromination process.

Using a standard bromate-bromide solution for the bromination'titration it was found that by carrying out the titration in sulphuric acid (hydrochloric acid is unsatisfactory) of 10 N. concentration it was possible to prevent completely the bromination of G-acid, whilst Schæffer's and R-acids brominated quantitatively; in this manner it is possible to determine within I per cent, accuracy Schæffer's and R-acids in the presence of G-acid. Also, instead of using starchiodide for determination of the end point in the usual manner it was found better to use a potentiometric method following the Hildebrand; arrangement.

It was also found that Crocein acid alone did not brominate in 10 N. sulphuric acid and thus resembled G-acid. This fact enabled Schæffer acid to be estimated in a mixture of Crocein and Schæffer's acids by the above described method, but unexpectedly unreliable results were obtained in estimating similarly a mixture of R- and Crocein acids. Finally it was found possible to avoid this difficulty by adding a considerable excess of bromide and titrating at 30 C. instead of room temperature. Forrester and Bain have thus been able to describe accurate methods for determining Schæffer or/and R-acid in the presence of Crocein or/and G-acid.

Antiseptics for Sized Cotton

Rare earth antiseptics for sized cotton.—A short time ago it was discovered by the Shirley Institute that thallium carbonate was very effective as an antiseptic, and was thus suitable for adding to farinaceous sizing pastes such as are necessary for preparing cotton warp yarns for weaving and which in the presence of excessive moisture readily develops Unfortunately thallium carbonate is not available in sufficient quantity for the purposes of the textile industry, and it is also somewhat expensive. The Shirley Institute have since discovered a better antiseptic in Shirlan (the anilide of salicylic acid), but nevertheless it is interesting to notice that rare earths other than thallium have recently been patented as antiseptics. In particular it is found that been patented as antiseptics. the salts of zirconium, lanthanum, uranium, cerium, and thorium are good antiseptics, but it is claimed that thorium salts are especially valuable.

The following is a typical sizing composition containing a thorium antiseptic :-

Farina (potato starch)	224 lb.
Tallow	20 lb.
Soft soap	5 lb.
Glycerine	7 lb.
Caustic soda of 70 Tw	
Thorium sulphate or fluoride	ı lb.
Water	220 gallor

Generally it is sufficient to add 1/2 to 2 per cent. of a thorium salt to the sizing mixture.

^{*} J. Soc. Chem. Ind., 1930, 49, 410T, and 423T. † Chem.-Ztg., 1893, 17, 1265 and 1897. † J. Amer. Chem. Soc., 1913, 35, 851. § J. Text. Inst., 1930, 21, 245T.

Nitro and Amido Compounds*

Safe Practices in Production of Dyestuffs and Explosives Materials

THE manufacture of nitro and amido compounds occurs chiefly in connection with making dves and explosives. The manu facture of dyes in the United States has grown by leaps and bounds since the war, and while a considerable amount of explosives was manufactured before the war it was the war experience that brought to the front the necessity for the study of the hazards in the industry. Fortunately, most of the smaller plants have been closed, and improvement in working conditions has been hastened by the concentration of We will dve intermediate manufacture in a few large plants. not attempt to describe the processes used in the manufacture of nitro and amido compounds, but will confine ourselves in this discussion to the dangers resulting from the manufacturing process and the safe practices to be pursued.

Two of the most important nitro compounds are Mononitrobenzene ($C_6H_5NO_2$) and Metadinitrobenzene ($C_6H_4(NO_2)_2$). The first is a yellow oily fluid, smelling like oil of bitter almonds, insoluble in water but readily soluble in fats. It therefore passes easily through the skin and may cause poisoning in this way, or by the inhalation of fumes. Occasionally it is spilled or splashed on the skin and then the symptoms of poisoning come on very quickly. If the clothing is soaked with nitrobenzene the resulting collapse may be very sudden

Dinitrobenzene (meta) is a solid, which volatilises at ordinary This compound is considered the most room temperatures. useful that is used in aniline-dye manufacture. It is not more poisonous than mononitrobenzene, but the requirements of manufacture are such that men are necessarily brought in contact with it to a greater degree and industrial poisoning is, therefore, harder to control. The symptoms of acute poisoning are no different from the poisoning from nitrobenzene. However, there is a more chronic form which makes this compound more troublesome. The workers who are affected become emaciated and weak, the skin takes on a dirty yellow colour, the pulse becomes weak, there is dizziness, and a narrowing of the field of vision. The blood becomes chocolate coloured and there are disturbances of sensation, especially a feeling of cold and weight in the legs.

Danger in Dinitrobenzene

In American establishments dinitrobenzene, or DNB, as it is called, is the only substance that causes real alarm and in There is more exhaustion, more fact it is much dreaded. weakening of the heart, than in poisoning from aniline, and the effects of an acute attack last much longer, dragging on sometimes for days and weeks.

It is not only in the production of DNB but in its use as an intermediate, such as for reduction to metanitraniline, that the danger arises. Formerly DNB used to be run out into open pans, where it caked, and men were sent to chop up the cake and shovel the fragments into trucks, in the course of which a great deal of poisoning occurred. Later this method was generally abandoned, and the molten DNB is now usually run out to meet a stream of cold water, which granulates it. However, the handling of this material after it has solidified may expose the men to sufficient fumes to poison them because of the property of the material to volatilise at room temperatures

wo other nitro compounds should also receive consideration. Or tho and paramononitroluene $(\mathrm{C_6H_4CH_3NO_2})$ are used to produce by reduction the important intermediates ortho and paratoluidin. During the war it was used as a stage in the manufacture of TNT and it is also used in the manufacture It is generally considered that the ortho is most poisonous of the mononitrotoluenes, but neither the ortho or the para is a toxic as mononitrobenzene. They act more slowly and seemingly only on susceptible subjects, for many men can handle them without any trouble.

The French and German authorities, who made very exhaustive investigations of the poisonous effects of DNT and TNT during the war, seem to feel that the pure substances are only slightly toxic. The worst place in a nitrating department

for DNT is the centrifuge for the separation of DNT from other products of nitration, and the men engaged in such work believe that the oily liquid which separates off and is rejected is the source of the trouble.

Trinitrotoluene is a slow acting poison and affects about onethird of the people exposed to it. Injury to the bone marrow causes a great destruction of red blood cells and as a result a hematogeneous jaundice develops. Trinitrotoluene is not used in dye manufacture but it is important in this connection because TNT poisoning may serve to give a better understanding of the effects of similar compounds that are used in dye

In addition to the compounds already mentioned, there are the nitronophthalenes ($C_{10}H_2NO_2C_{10}H_6$ (NO_2)₂ etc.), and anisol ($C_0H_5H_3O$), which should be thoroughly investigated by all establishments manufacturing or producing them. Their poisonous effects are very slight and some people consider them practically harmless. Nevertheless the possibility of poisoning is there, and the proper precautions should be taken

Before leaving the nitro group, it is important to call attention to one other compound. It is dinitrophenol 1-2-4. It is important because its physiological action differs so radically from the action of all the other known nitro derivatives of the benzene ring. The investigations that have been made by the British, the French, and the United States Public Health Service have developed the following essential facts.

Varieties of Intoxication

There are three varieties of intoxication

The first is mild, subacute, which serves as a warning to remove the workman from danger in time. There is loss of appetite, nausea, vomiting, colic and diarrhea, weakness, There is loss of headache and dizziness. The second form is acute. The onset is sudden with a complaint of extreme weariness in the limbs, painful constriction at the base of the chest, and a burning thirst. Respiration is short and difficult especially on inspira-tion. The Derrien reaction test of the urine increases in intensity as compared with the first variety. Removal from work, with a rest cure is usually productive of a rapid recovery, but no immunity follows the attack. The third form is but no immunity follows the attack. The third form is fulminating intoxication. The onset is sudden with attacks of weakness, violent colics and diarrhœa. In a few hours a temperature of 104 degrees may be reached and there is intense thirst. Unconsciousness, coma, and death may follow in a few hours.

It is not likely that poisoning from this compound will occur in dye works except as the result of some accident, or leakage.

Considerable time has been spent in analysing the nitro ompounds. Only brief mention will be made of the amido compounds. Only brief mention will be made of the compounds because the symptoms are less serious. cyanosis is deeper with an amido compound, the prostration is not as severe. The effects of the nitro group on the nervous system, changes in pulse, respiration, and body temperature are much more grave with dinitrobenzene than with the amido compounds. Literature on the subject gives a very complete history of the effects of aniline poisoning which it is not necessary to repeat.

The Toluidines

The toluidines $(C_2H_4CH_3NH_2)$ ortho and para are considered by many to be more toxic than aniline. In some plants the toluidines are said to give more trouble than the aniline, not necessarily because they are more poisonous but because there is not any process in aniline manufacture except repairing and cleaning which necessitates as much exposure to fumes and contact as does the centrifuging of the two toluidines.

The diamines $(C_6H_3H_3(N_2H_2)$ are notoriously toxic; the phenylendiamines $(C_6H_4(NH_2)_2$ such as are used in the dying of furs and which cause very severe eczema ulcers and cellulitis in fur dyers, and sometimes in furriers and wearers of dyed furs; nitraniline (C6N4NH2NO2) which is quite toxic, isomers of which cause very distressing, burning, and itching skin eruptions and in some cases serious and even fatal systematic poisoning. Methyl and ethyl aniline, which may contain some unchanged aniline and several others of the amido compounds which are more or less productive of industrial

^{*} From a paper by Mr. Cyril Ainsworth before the National Safety Congress at Chicago.

poisonings are important enough to receive the very serious consideration of those engaged in their use or manufacture.

It has already been mentioned that a much better control of these industrial poisons exists at the present time than was the case during the war because so many of the smaller plants which were hurriedly constructed for war purposes have stopped operations, and the manufacture is now concentrated in a few large companies. This has brought about better constructed buildings. The mechanical apparatus used is better constructed and arranged. The processes themselves are conducted in such a way as to make contacts with the compounds by the workmen unlikely.

Lessons Learned by Experience

From the experience of the past we have learned the following lessons:

The buildings in which nitro and amido compounds are constructed should have the best ventilation that it is possible to secure. The floor should be of non-absorbent material, smooth and easy to clean. The walls should be calcimined at least once a year and otherwise be kept clean. If any nitro and amido compounds are spilled on the floors they should be removed as soon as possible and the floors should be regularly cleaned every 24 hours.

It is necessary that the employees be acquainted with the poisonous quality of the compounds in order that they will be impressed with the necessity of complying with the health rules which have been established. Shirts, overalls, caps, stockings, shoes, gloves, and other wearing apparel which may have become saturated with poisonous compounds should be immediately taken off, the skin washed, and clean clothing put on. Employees should be warned that the use of alcoholic liquors and chewing tobacco is harmful to their health.

The keeping or eating of food in the workroom must be absolutely prohibited. A suitable dining room absolutely separate from the workroom should be provided, and employees should not be allowed to enter the room until they have washed both face and hands. Process men should be provided with two lockers, one for street clothes and one for working clothes. Everything possible should be done to get the process men to take a bath daily before they leave the plant and they should be cautioned against starting work on an empty stomach.

empty stomach.

It is vitally important that all process men be physically examined by a licensed physician before commencing work and at least once in every thirty days thereafter. Men who suffer from inflammation of the bladder or who are addicted to the use of alcoholic liquors or who suffer from excessive perspiration should not be employed.

From these recommendations it will be seen that cleanliness is the watchword in the manufacture of nitro and amido compounds. Cleanliness in building maintenance, cleanliness in personal habits of employees and cleanliness in conducting the process

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

As is commonly known, the House of Lords was able to force upon the House of Commons the continuance of the Dyestuffs (Import Regulations) Act The Manchester Guardian comments as follows:—

"The trade had had a great disappointment in the matter of the Dyestuffs (Import Regulation) Act. This Act, which prohibits the import of dyestuffs except under licence, was to have expired next month, after being in operation for ten years, during which it has hindered Lancashire's access to new colours, and thus prevented the improved business in printed and dyed cloth which might have been expected to provide some compensation for the falling off in plain grey goods. Although the Government promised that the Act should lapse at its appointed date, considerable opposition developed in Parliament, and it was found advisable to let the restrictions remain in force for another year."

So far as the writer's experience goes, dyers in Lancashire have not expressed or given any other evidence of great disappointment in that the Dyestuffs Act has not been allowed to lapse.

As a consequence of ten years of the operation of the Act, many dyers and printers have come to regard the practical exclusion of certain foreign dyestuffs as being an ordinary normal condition of things, and have been content to make use of those dyestuffs which were available with the minimum of trouble.

Some of the large combines, as for example the Calico Printers' Association, have repeatedly stressed the importance to them of the ability to make use of German or Swiss improvements and novelties at the earliest possible moment, and the validity of this contention cannot be denied. From the makers' point of view, the present time would have been a singularly unfortunate one at which to drop the measure of protection which the Act has afforded. The general depression in the textile and other industries must have affected the output of dyestuffs to an appreciable extent. It is probably true that the margin between the lowest limit of economic production and production at the rate prevailing at present is quite narrow, so that the importation of dyestuffs hitherto excluded, if only in relatively small quantity, might make the difference between an economic and an uneconomic production. Anyhow, the dyestuff manufacturers have now got another year of shelter under the Dyestuffs Act.

The speech made by Major A. G. Church, M.P., at Bristol, explaining the reasons for his resignation of the Parliamentary Secretaryship to the Minister for War, would seem to show that the decision as to the policy to be followed in regard to the Dyestuffs Act is arrived at without any consultation with appropriate representatives of the services and of scientific institutions in the country. It is to be hoped that in the further year now available the Government will arrange for the whole question to be considered once again, in the hope that a solution will be obtained which will be satisfactory not only to users and makers but to the services and to those who regard the dyestuffs industry as a key industry from the point of view of the training of chemists and their dissemination into and influence upon the other industries of the

It is a truism to say that no solution can be acceptable to the textile trade which continues to impose in any fashion at all the burden of the protective measure upon the dyestuff user.

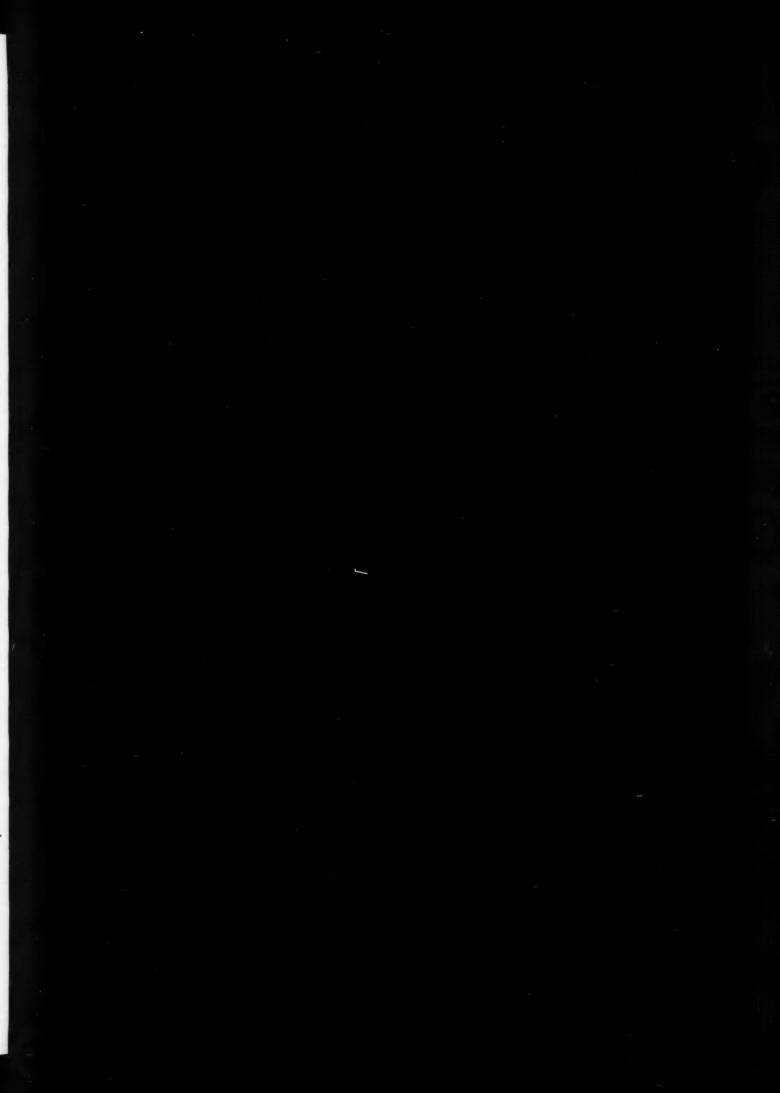
Scotland

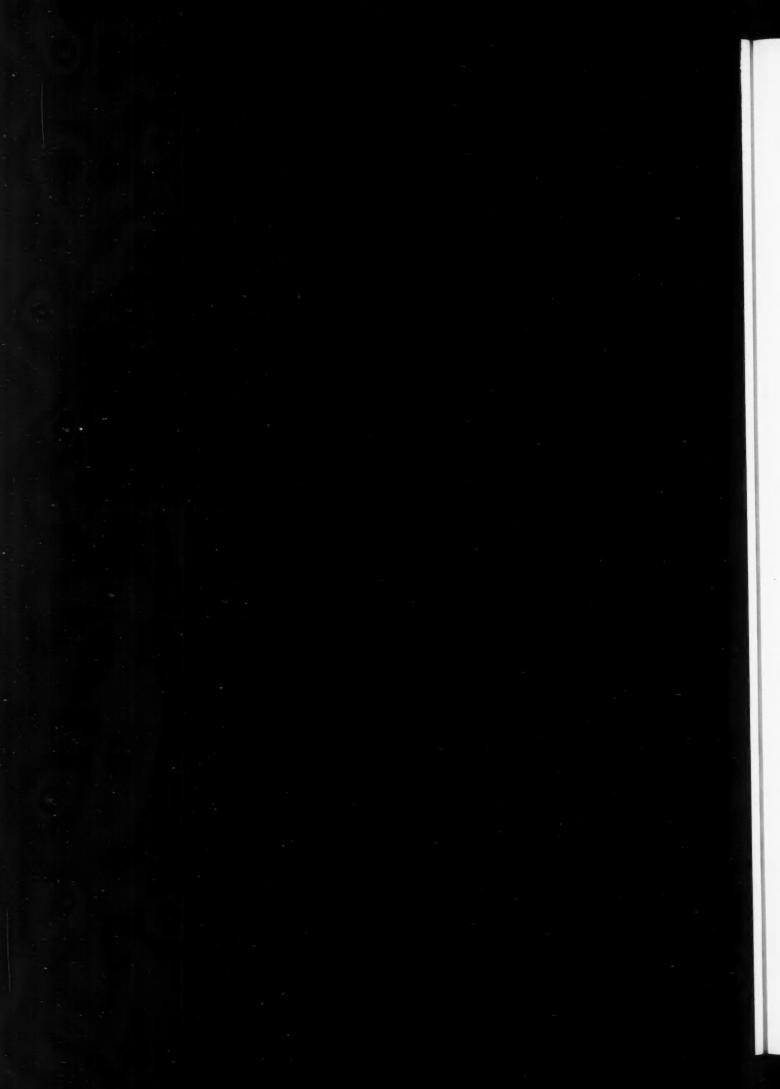
The new year opens with rather mixed prospects as far as the dyestuff industry is concerned. On the one hand, there is the great advantage that the Act is now to run for another year, and during the year the question of the future is to be thoroughly considered. The struggle over this was a rather prolonged and interesting one, and one of the most satisfactory features was the fact that the further the matter went the more it became evident that among those best in position to know in both the making and using industries, there was substantial agreement on the most important issues. On the other hand, the question of the introduction of the new type of loom into Lancashire is, of course, an uncertainty in the textile outlook, but it is to be hoped that there will be no substantial stoppage.

The Scottish tweed trade is showing little change, a proportion only of manufacturers being able to run full time. In Jedburgh the artificial silk factory is to re-start.

There was a slight falling off in dyestuff sales during December, and now that the holidays are over, some slight increase is anticipated.

Speaking generally, it is to be hoped that we have now reached the bottom of the trough of depression, and that the coming year may show an improvement.





Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

British Fast Dyes

The exhibit of British dyestuffs to be shown at the Artificial Silk Exhibition at the Albert Hall on Monday next, February 16, affords ample proof of the lead that British dyestuffs hold in the field of dyes for artificial silk. It demonstrates the excellent use which our dye-makers have made of the opportunities afforded them by the Dyestuffs Act. Artificial silk is the only textile in the dyeing of which the new British dyestuffs industry was able to start on equal terms with competitors. The result is that in the treatment of artificial silk British dyes are supreme.

Included in the wide range that will be shown at the Albert Hall, special interest will centre in an evening frock dyed with the famous Caledon jade green described as "the world's fastest dye." The product of British chemists in a Scottish laboratory, this dye is of a brilliant green shade and is the most famous member of the Caledon range. Another interesting development is on the Duranol colours. For some time artificial silk of the acetate type, as opposed to the pure cellulose, could not be dyed satisfactorily. Here, again, the problem was solved by the British discovery of what is now known as the Duranol range of dyes, which, though of outstanding fastness, can be used with the utmost simplicity. Examples of the application of these colours will be shown in several articles of ladies' clothing. Ranges of both colours will be shown on the stand arranged by Imperial Chemical Industries at the Albert Hall.

Dyestuffs Licences for January

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 712, of which 570 were from merchants or importers. To these should be added 16 cases outstanding on December 31, 1930, making a total for the month of 728. These were dealt with as follows:—Granted, 660 (of which 605 were dealt with within seven days of receipt); referred to British makers of similar products, 39 (of which 20 were dealt with within seven days of receipt); outstanding on January 31, 29. Of the total of 712 applications received, 625, or 86 per cent., were dealt with within seven days of receipt.

New I.C.I. Colours

Six new colours are announced by Imperial Chemical Industries—Thionol Red Brown 3RS, Thionol Red Brown 6RS, Solochrome Blue RAF, Chlorazol Diazo Blue 2RS, Chlorazol Blue GS, and Chlorazol Purpurine 10BS. Thionol Red Brown 3RS and 6RS are practically identical in general fastness and dyeing properties. The main difference between the two is in shade, the "6RS" brand being redder, brighter and approximately double the concentration of the "3RS" brand. These colours are suitable for dyeing all types of cotton materials, but are especially interesting for dyeing cotton hanks, warps and loose cotton for the production of reddish brown shades fast to washing, milling, cross-dyeing and acid. They may be applied in circulating machines for dyeing cops, beam warps, etc. They may also be used for dyeing viscose artificial silk.

Solochrome Blue RAF is of considerable value for the production of blue-grey shades where exceptionally good fastness is required. In this connection special mention

must be made of the excellent fastness to milling and light, on account of which it is eminently suitable for the dyeing of slubbing and loose wool. It possesses good solubility and is therefore suitable for application in the various types of circulating machines. Solochrome Blue RAF may be applied by either the afterchrome or chrome mordant processes, the former giving dyeings of somewhat superior fastness.

Chlorazol Diazo Blue 2RS is one of the most important of the direct cotton dyestuffs capable of being developed on the fibre with beta naphthol. The direct shade, although possessing average fastness, is relatively of little importance compared with the developed shade. When developed with beta naphthol it gives bright reddish blues possessing very good all round fastness properties, the most important of which are light and washing. In addition the fastness to acids, alkalies, perspiration and vulcanising may be described as very good. The possession of very good all round fastness properties makes this colour of interest for dyeing all types of cotton materials of which special mention must be made of piece goods, warps and also yarns for the hosiery trade. This colour is also of value for dyeing silk and artificial silk, and is of interest for paper dyeing. It possesses excellent discharge properties, and is extremely valuable as a ground shade (direct or developed beta naphthol) for the production of white or coloured discharge effects using either formosul or tin crystals.

Chlorazol Blue GS

Chlorazol Blue GS, although applicable to all types of cotton materials for the production of bright greenish blues, is of special interest for dyeing cotton pieces and warps, and also materials such as cops, beam warps, etc., in circulating machines. It possesses very good solubility whilst its dyeing properties are exactly suited to the above types of It possesses very good fastness to acids, rubbing and vulcanising, three very important factors in piece dyeing. It may be after-treated with copper sulphate, giving much redder shades, whilst the fastness to light becomes equal to that of the best direct cotton dyestuffs. It possesses very good discharge properties and is of interest as a ground shade for the production of white discharges by means of formosul or tin crystals. It is of interest for union dyeing in that the shade on wool or silk is very close to that on cotton. It is also suitable for dyeing silk, artificial silk, jute, tagal, wood chip and paper.

Chlorazol Purpurine 10BS is applicable to all types of cotton materials and for all purposes where direct cotton reds of average fastness and good shade come into consideration. It may be regarded as being similar in general properties to benzopurpurine 10BS, but possesses the advantage of being faster to acids and is brighter in shade. It is particularly suitable for dyeing union materials, giving solid shades on wool-cotton and silk-cotton union mixtures. It is easily discharged and is of interest as a ground shade for the production of white discharge effects with formosul or tin crystals. It is applicable to silk and tin weighted silk giving shades of good fastness to water and washing. It may also be used for dyeing viscose artificial silk but does not give even shades on material of irregular quality. It is suitable for dyeing paper and may be sized with sulphate of aluminium without showing appreciable change in shade.

Dyes and Dyeing: Technical Progress in 1930 By L. J. Hooley

DURING 1930 developments proceeded along similar lines to those of the last few years, with, as far as can be seen, no outstanding new discoveries. In the following comments are made on a selection of the more important or interesting of the year's publications.

Dyeing and Printing

Many of the improvements coming under this heading have been already dealt with during the year, but further ones may be mentioned here.

Difficulty is sometimes experienced in obtaining complete penetration when dyeing close fabrics made from strongly twisted yarns or dressed fabrics, canvases, etc., with vat colours. In B.P. 305,230, the addition of an agent promoting bleeding or running as distinct from wetting is recommended for this, the cloth being treated with a solution before dyeing; amongst the substances mentioned is sulphonated oleic acid A reserving agent for wool for use in dyeing this material in admixture with cotton with direct cotton dyes, consists of a water-soluble sulphonic acid obtained by condensing a resin with an aralkyl_thalide and then sulphonating. Similar reserving agents are soluble sulphonic or carboxylic acid amides in which the amino groups are substituted by alkyl or similar residues (B.P. 304,742, 333,554, I.G.F.A.-G.) A polyvinyl alcohol is recommended for printing pastes with vat or sulphide colours, the cloth printed in this way but with no alkali being slop-padded in a reducing bath and then steamed without danger of the colour running (B.P. 329,207 I.G.F.A.-G.). M. Jeanmaire and L. Ebersol describe a new process for printing with vat dyes, in which the cloth is printed with a paste of the unreduced dye and a thickener, the colour being developed in the jig with an alkaline reducing bath (Chim. et Imp. 1929, Spec. 493).

The cellulose ethers recommended for printing vat colours

The cellulose ethers recommended for printing vat colours are now applied for printing aniline black along with vat colours. After printing the aniline black is developed and the cloth then padded in an alkaline reducing bath and steamed without drying; reserve effects can be obtained also

(B.P. 311,740 and 311,779 I.G.F.A.-G..).

Titanous salts can be used both for reducing vat dyes in alkaline solution and for discharge printing; complex salts are preferable (B.P. 330,646 and 330,563 I.G.F.A.-G.). A method of obtaining coloured effects on textile goods by transferring from paper is described in B.P. 311,741 (I.G.F.A.-G.). The Calico Printers' Association and J. D. Webster (B.P. 326,823) print a fabric first on one side with one coupling component and then on the other with a different one, and after drying, pass through a single diazo solution and obtain the same pattern in different shades on the two sides. New methods of developing enolic ester salts of vat dyes comprise steaming with a chloride, ester or anhydride of an organic acid, development with ammonium iron alum and electrolytic development. R. Haller and C. Zieech recommend sodium-m-phosphate and thiourea for after-treating dyed fabrics to increase fastness (J.S.D.C. 1930, 217). A. Nistler (Kolloidchem. B. 1930, 1) describes a micro method for examining the dispersion of dyes by determination of their diffusion coefficients. Results concordant with those of other methods are reached.

Immunisation

Additional methods of immunisation include direct esterification with maleic anhydride without a catalyst; pretreatment of the fibre with a catalyst—e.g., impregnation with copper sulphate and drying, before acylating, which then takes place readily; addition of a tertiary base in acylating with the anhydride or chloride of the organic carboxylic acid (B.P. 315,434-5, 319,584, S.C.I.B.). Another method is to first treat the cellulose with alkali and then with an aromatic or heterocyclic sulphonic acid residue of basic character (I.G.F.A.-G., B.P. 322,556).

A woolly effect may be imparted to vegetable fibres along with a resistance to wetting and direct dyes by treating with alkali followed by a superficial esterification with an acyl halide (B.P. 313,616 Heberlain and Co.). A. E. Woodhead has dealt with the mechanism of immunisation and the dyeing and printing of immunised cotton with the different groups

of dyestuffs (J.S.D.C. 1930, **69**), and J. G. Grundy (J.S.D.C. 1929, **142**) has given a tabular synopsis of the properties of the main groups of dyes suitable for producing effect threads on mixed fibres.

Cellulose Acetate

New dyestuffs for this material include products containing "ar" tetrahydronaphthylamine nuclei, these being obtained by condensing an ar-tetrahydronaphthylamine with 1-chloro2: 4-dinitrobenzene or another aromatic nitro compound containing reactive halogen, the products are generally orange to red (B.P. 330,591, 330,602, Brit. Celanese and H. C. Olpin). Secondary diazo dyes of the type A→B→C, where A represents aniline or its homologues or halogen derivatives, B represents dinaphthylamine or its 6- or 7-acid, and C is 1:5-naphthylenediamine or 1:5-aminonaphthol, are suitable for obtaining black shades on acetyl silk (B.P. 314,651, I.C.I., E. A. Speight). Quinoline compounds free from acid groups when coupled with diazo compounds also give acetyl silk

E. A. Speight). Quinoline compounds free from acid groups when coupled with diazo compounds also give acetyl silk dyes (B.P. 527,394 I.G.F.A.-G.).

With the development of proper processes and adequate control, delustring is becoming a more important method for obstaining an acid acceptance of the control obtaining various celulose acetate effects and is now used deliberately rather than of necessity, as when suitable dyes for the unhydrolysed fibre were lacking. In B.P. 330,504 (Brit. Celanese and W. I. Taylor) delustred threads are prepared by dry or wet spinning solutions of the acetate containing a wetting-out agent, and then removing these by steaming. White or matt effects are produced by printing with a solution of urea thickened with a gum and drying and steaming (B.P. 309,194 I.G.F.A.-G.). One method of overcoming the discharging difficulty is to print the hydrolysed material with a dischargeable dye and carry on in the usual way. Fabrics with warp print effects are obtained by weaving a warp or weft of a hydrolysed acetate with an untreated acetate and then printing with the dye which only has an affinity for one (B.P. 317,455, Brit. Celanese). P. E. King and A. R. Sahasranam (*J.S.D.C.* 1930, **118**) discuss the absorption of tannic acid by cellulose acetate and its dyeing with basic dyes. Textile materials may be printed with a solution of dye in cellulose acetate, this being a method which does not require after-treatment and is applicable to all textile materials, but it gives only very limited fastness to washing (*Melliand*, 1929, I, 950-953; Kemmerich, W.E.). E. Clayton (*J.S.D.C.* 1930, **367**) develops a theory of the dyeing of cellulose acetate based on its behaviour towards dyes of the Duranol type and picramic and picric acids. Dyeing appears to depend essentially first of all on a high dispersion of the dye particles in the dye liquor and then on the particles dissolving in the fibre, and being uniformly distributed there. Another interesting theoretical paper is that of St. Jost (Rayon Record, 1930, 4, 479-483).

Anthraquinone Dyes

In the anthraquinone section vat dyes have almost monopolised attention, only a little having been given to the acid alizarines and alizarines. The Newport Co. have found that the dichlorobenzoylbenzoic acid obtained from m-dichlorobenzene, nitrates to give an acid which reduction and cyclisation converts to the useful 1-amino-2:4-dichloroanthraquinone (I. Gubelmann, H. J. Weiland and O. Stallmann, Ind. Eng. Chem. 1929, 1231). The same authors have also described an interesting method of making ββ derivatives, by nitrating p-sulphobenzoylbenzoic acid, reducing and ring-closing, nitration taking place this time in the other half of the benzoylbenzoic acid (B.P. 327,130). In the sulphonation of quinizarine, use of the boric ester gives the 6-sulphonic acid instead of the 2-isomer (B.P. 308,359, I.G. F.A.-G.).

1-Aminoanthraquinone-2-carboxylic acid ethyl ester is formed by the hydrolysis of anthraquinone-1: 2-iso-oxazole with alcohol (B.P. 314,028 I.G.F.A.-G.). A number of new 1: 4-diaminoanthraquinones or 1-amino-4-arylaminoanthraquinones have been described, these being generally substituted in the 2-position and often also carrying other substituents in the groups in the 1- and 4-positions. Aminochloro-anthraquinones are obtained from aminoanthraquinone sulphonic acids by oxidising the amino group before replacing

the sulphonic group with halogen (B.P. 331,537, S.D.L., R. J. Loveluck, J. Thomas and E. G. Beckett).

Coming to the vat dyestuffs further attempts have been

made to improve the manufacture of indanthrone by the alkali fusion of 2-amino-anthraquinone, the variations introduced being generally in matters of detail. Scottish Dyes have described some new halogenated indanthrones (B.P. 330,217,

W. Smith and J. Thomas).

Further recipes for the halogenation of pyranthrone have been detailed, the products being useful either directly as dyes of orange to red shade, or indirectly for condensation with amines, phenols, etc. Some of the condensation products may if desired be further halogenated, to give dyes such as bromodiphenoxy-pyranthrone which is a reddish-brown vat dyes (B.P. 329,357, I.G.F.A.-G.). 1-Nitroanthraquinone-2-carboxylic acid is converted directly to an anthraquinone acridone by heating with an arylamine in nitrobenzene at 200° in presence of nitrobenzene (B.P. 324,084, Brit. Alizarine Co., and P. P. Beghin). Noticeable attention has also been paid to the halogenated anthraquinone acridones, products with both chlorine and bromine and with as many as 4 to 5 atoms in all being mentioned.

Crude benzanthrone can be purified by dissolving in concentrated sulphuric acid, diluting to about 65% strength and extracting the precipitated pure benzanthrone by treating the acid suspension with toluene (Newport Co. B.P. 305,536). α -Naphthoylbenzoic acid, which is a convenient potential source of a benzanthrone carboxylic acid, has previously resisted attempts to so utilise it, because ring-closing agents

have always given naphthanthraquinone. The I.G.F.A.-G. however have now found that sodium-aluminium chloride at 100° C. gives a body which probably has the constitution shown (B.P. 303,395).

Light may be thrown on the difficulty of preparing pure and definite methylbenzanthrones by the discovery that wandering of the methyl group readily takes place—the methyl derivative from phenyl-4-methylnaphthyl ketone being identical with that from 2-methylanthraquinone and glycerine (Ber. 1930, 1,464). Halogen, nitro-, or hydroxyl-groups when introduced into 3-alkoxybenzanthrones by the known methods are found to enter into position 2. 2-Acetonylbenzanthrones and thioethers of the type Bnz.S.CH2.COR. are converted to 2-alkylbenzanthrones by alkaline hydrolysis (I.G.F.A-G. B.P. 322,253) the reaction recalling certain synthesis of isodibenzanthrone from somewhat similarly substituted benzanthrones. Some further new methods of making direct blacks from dibenzanthrones and dibenzanthronyls, especially from those containing oxygen or nitrogen derivatives, have been described; many of these are of undetermined constitution.

(To be continued.)

Basic Intermediates for Dyestuffs: No. XL.—Derivatives of the Anthraquinone Series.—Part 3.

By "Consultant"

In the previous contribution to this series (No. XXXIX) a classification was made of some of the more important derivatives of the anthracene series containing condensed rings, and of these classes two, the true Indanthrenes and Violanthrones were discussed in detail. In this article it is proposed to describe the remaining members of the series.

The Pyranthrones

We owe our more certain knowledge of the constitution of pyranthrone itself to Scholl, who was able to synthesise the compound by the action of aluminium chloride (anhydrous) on dibenzoylpyrene at high temperatures. Pyranthrone is formed by the elimination of four atoms of hydrogen. (See formulæ 7 and 8.)

Although this method has been the subject of a patent (D.R.P. 239,671), it is not the main method by which pyranthrone is produced commercially, owing to the difficulty in obtaining an adequate supply of the raw material. In the method used commercially, the starting point is 2-methylanthracene. successive conversion of this compound into 2-methylanthraquinone and into the large molecule, 2:21-dimethyl-1:11dianthraquinonyl, has already been described in Part XXVII of this series. Pyranthrone is formed from this compound by the loss of two molecules of water (9). The condensation can be effected by fusion with zinc chloride, with alkaline sodium acetate or simply by baking the compound at 350 to 380° C. When zinc chloride is used, the usual commercial process, about 100 lb. are melted in a fusion kettle and the finely powdered dimethyl-dianthraquinonyl (10 lb.) added little by little, so that the temperature is maintained at about 290° C. The fusion is a short one, and should be stopped about half an hour after the addition of the dimethyldianthraquinonyl has been completed. Extraction of the product is a simple operation, the cooled and ground melt being extracted simple operation, the cooled and ground melt being extracted with hot dilute hydrochloric acid and the pyranthrone filtered off as a deep coloured powder. Under the name Indanthrene Gold Orange G or Duranthrene Gold Orange Y, it has been used as a deep golden yellow colour. The Pyranthrone vat can be produced straight away from the dimethyldianthraquinonyl by heating the latter under pressure with a solution of potassium hydroxide in alcohol. The two molecules of water are split off, with the consequent reduction of the intermediate to pyranthrone, but in addition reduction takes place, a tetrahydro derivative being produced. It is cherry red in solution, and is identical with the compound obtained by reducing pyranthrone itself by alkaline hydrosulphite solution. The systematic name for Pyranthrone (8) is 9:1:2-21: 11-91-naphthadianthrone, and it is almost the only derivative of the series that finds any substantial use in commerce.

The Trianthraquinonylamines

The compounds of previous contributions on the derivatives of the anthraquinone series have all been derived from the permutations and combinations of the basic nucleus in condensed form. There are one or two intermediates and dyes of importance that are obtained from the joining together of three anthraquinone residues in chain formation. Such compounds are usually referred to as "trianthraquinonylamines," but a more suitable and less ambiguous name is anthraquinonyldiaminoanthraquinones. There are thirty-four possible members of the series, but only the 1:5-di-\$-anthraquinonyldiaminoanthraquinone derivatives are of value, those from the other isomers being either difficult of access or devoid of fast dyeing properties. The starting point for the synthesis of 1:5-di-\$-anthraquinonyldiaminoanthraquinone is 1:5-diaminoanthraquinone, the preparation of which was described in Part XI of this series. This compound (finely ground) is mixed with one-half a molecular proportion of 2-chloranthraquinone, and the mixture treated with one-tenth of its

$$\begin{array}{c} CO & NH_2 \\ NH_2 & CO \\ \end{array}$$

$$\begin{array}{c} CO \\ +2 \\ CO \\ \end{array}$$

$$\begin{array}{c} CO \\ -NH & CO \\ CO & NH \\ \end{array}$$

$$\begin{array}{c} CO \\ CO \\ \end{array}$$

$$\begin{array}{c} CO \\ -NH & CO \\ \end{array}$$

$$\begin{array}{c} CO \\ -NH & CO \\ \end{array}$$

weight of anhydrous sodium acetate containing to per cent by weight of cuprous chloride. The reaction mixture is maintained at 320° C. until a sample shows the correct colour on diluting with water and warming with sodium hydrosulphite. Extract of the fusion residue with warm water leaves the dye as a dark brown powder. It dyes a cherry red of considerable fastness, and has been sold under the name of Indanthrene Red RG, and Chloranthrene Bordeaux R is a similar derivative.

The Hetero Derivatives

The presence of fused rings attached to anthraquinone in which nitrogen or sulphur constitutes the hetero-atom, leads to the formation of a number of interesting compounds. The parent compounds of the series are the anthraquinone acridones, of which there are three (12 to 14). In addition, there is a series of dianthraquinone acridones which are,

however, less important. Of the three simple anthraquinone-acridones the 1:2-derivative is the most valuable, and may itself be prepared by the original method of Ullmann. The

process is as follows. The two intermediates, I-chloranth-raquinone and anthranilic acid are condensed with the formation of anthraquinonylanthranilic acid, which loses water with ring closure on heating with anhydrous aluminium chloride. The details of this process do not differ in any way from those described in connection with similar products, and for this reason are not repeated here.

When substituted derivatives of anthranilic acid are used, the substituents are to be found in the final compound, which in certain cases is suitable for use as a dye. Thus, starting with 4-chloroanthranilic acid, Duranthrene Red BN (Indanthrene Red BN extra) is obtained (15). The 2:1-anthra-

quinoneacridone (13) has no derivatives of great value, since the dyes formed when it is substituted are somewhat unstable to alkalies. It has the curious property of condensing with hydrazine with the loss of two molecules of water to form a cyclic diazine of the formula (16).

Similar compounds in which the nitrogen of the heterocyclic ring is replaced by sulphur can be obtained by starting with various derivatives of thiophenol. Such compounds are really derivatives of anthraquinonethioxanthone, of which there are many isomeric forms. Of these the one which corresponds to the 1:2-anthraquinoneacridone is the more important. It is obtained by the condensation of thiosalicyclic acid with chloranthraquinone exactly in the same manner as the condensation with anthranilic acid. As with the latter compound, the process takes place in two stages, with the formation of anthraquinonyl thiosalicylic acid, followed by internal condensation with the removal of the elements of water, usually in the presence of anhydrous aluminium chloride (17). An

alternative, but less readily accessible, method for the preparation of this group of substances is through the condensation of thiophenol with r-chloro-anthraquinone-2-carboxylic acid. This latter compound is not easily prepared, so that the former synthesis of thioxanthones is the more useful commercially. There are two members of this series which have been commercially exploited, namely, Duranthrene Yellow GN (18), which is the compound from 2:4-dichlorthiophenol and Duranthrene Gold Orange GN (19), an isomeric compound from 3:4-dichlorthiophenol.

There is also, it must be mentioned, a number of compounds to which the term "Indanthrene" has been attached which are of indefinite constitution, and which do not yield simple products on decomposition. Thus, Duranthrene Olive GL (Indanthrene Olive G) is obtained by heating anthracene with sulphur, while the Indanthrene Grey and Maroon were produced by condensation of formaldehyde and diaminoanthraquinone, followed by alkali fusion.

New Application of Aqueous Pastes to Dyes*

A DISADVANTAGE commonly met with in aqueous pastes of more or less finely divided material is the tendency to coagulate and settle, so that the paste after being kept for a longer or shorter time is no longer uniform in composition. addition of gums and other similar thickening material has been proposed, but these have their own special drawbacks such as liability to attack by fungi.

It has now been discovered that a polychlorinated naphtha-

lene sulphonic acid and its salts have especially valuable properties in this connection. The addition of 2 per cent. of sodium polychloro-naphthalene sulphonate (calculated on the total weight of paste) to an aqueous paste of duranthrene golden orange Y, for example, entirely prevents the settling out of the solid dyestuff, and the paste is found to be practically uniform in composition after standing for a long period of time. This effect is due to the formation of a stiff gel, which, however, is easily stirrable and thins rapidly when stirred or shaken.

Solutions or pastes containing polychloronaphthalene-sulphonic acid or its salts are not liable to deterioration by fungus growths. Our products have also valuable wettingout properties.

Formulation of a Gel

As long ago as 1849 Laurent (Liebig's Annalen, 72, 300) recorded the fact that the potassium salt of sulphonated tetrachloronaphthalene, when precipitated by water from the alcoholic solution, forms a gel, but hitherto no technical application of this property has been made, and no other salts have been prepared.

The compounds used are made by sulphonation of a polychloronaphthalene containing 3 to 4, 5 atoms of chlorine in the molecule. The polychloronaphthalene may be obtained by various known methods, particularly by the process described in British application No. 291,849, filed March 4, 1927 (British Dyestuffs Corporation, Ltd., Payman and

In our co-pending application Serial No. 296,859, of which the present application is a division, we have described processes of preparing polychlorinated naphthalene sulphonic

acid and its salts, from polychloronaphthalene.

In the examples below the patentees describe preferred methods of applying the products, but the invention is not limited to the details there given, either of the particular sulphonating agent used in Example 1 of the co-pending application Serial No. 296,859, or of the exact proportions of the reagents in any of the examples. The parts are by weight.

Example 1

To 100 parts of 12.5 per cent. paste of duranthrene golden orange Y, 25 parts of a hot aqueous 10 per cent. solution of sodium trichloronaphthalene sulphonate. (The sodium tri-chloronaphthalene sulphonate may be obtained from polychloronaphthalene containing 3 atoms of chlorine per molecule in the manner shown in Example 1 of our co-pending application, Serial No. 296,859.) The whole is stirred and allowed to cool. The product is then ready for storage without risk of settling.

Example 2

Fifty parts of a hot aqueous solution of sodium trichloronaphthalene sulphonate of 10 per cent. strength are mixed with 200 parts of an aqueous paste of thioindigo in a fine state of division, containing 25 per cent. of the pure dyestuff. The mixture is thoroughly agitated and then allowed to cool, after which it may be stored.

Example 3

Two hundred parts of an aqueous paste of the dyestuff obtained by coupling 1:2:4-dinitroaniline with beta-naphthol, containing 25 per cent. pure dyestuff, are mixed with 50 parts of a hot aqueous solution of sodium trichloronaphthalene sulphonate and the mass allowed to cool; where-upon a paste essentially free from the disadvantage of settling

What Inventors Claim

- 1. An aqueous paste comprising an alkali salt of polychloronaphthalene sulphonic acid containing 3 to 4.5 atoms
- * U.S. Patent No. 1,777,038, September 30, 1930, granted Wilfrid Gibson, A. J. Hailwood and Arnold Shepardson, and assigned to I.C.I., Ltd.

of chlorine in the molecule, mixed with a substantially insoluble in hot water to a clear solution which at concentrations above about 1-5 per cent. sets on cooling to stirrable gel, the said salt showing in dilute aqueous solutions marked wetting out and frothing properties.

2. An aqueous paste comprising a polychloronaphthalene sulphonic acid mixed with a finely divided substantially

insoluble dye and water.

3. An aqueous paste consisting of a trichloronaphthalene sulphonic acid mixed with a substantially insoluble dye and

4. In the manufacture of aqueous dye pastes, the process which comprises mixing a substantially insoluble dye with a hot aqueous solution of alkali salt of a polychloronaphthalene sulphonic acid containing 3 to 4.5 atoms of chlorine in the molecule, and then cooling the mixture to form a stiff gel.

. In the manufacture of aqueous dye pastes, the proce which comprises mixing a substantially insoluble dye with a hot aqueous solution of sodium trichloronaphthalene sulphonic acid and then cooling the mixture to form a stiff gel.

6. An aqueous dye paste comprising sodium trichloro-naphthalene sulphonic acid mixed with a finely divided substantially insoluble dye, the said paste being a stiff gel which thins rapidly when agitated.

An aqueous dye paste comprising a sodium salt of polychloronaphthalene sulphonic acid containing 3 to 4.5 atoms of chlorine in the molecule mixed with a finely divided substantially insoluble dye, the said paste being a stiff gel which thins rapidly when agitated.

8. In the manufacture of aqueous dye pastes, the process which comprises mixing a substantially insoluble dye with a hot aqueous 10 per cent. solution of sodium trichloronaphthalene sulphonic acid and then cooling the mixture to form a

Structure of Cellulose Fibres

At a meeting on Friday (February 13) of the London Section of the Society of Dyers and Colourists, at Burlington House, London, Mr. John Preston presented a paper on "A new method of determining the structure of cellulose fibres."

The paper dealt with a new method for determining the structure and degree of orientation of the micelles of cellulose fibres, which depends on quantitative measurements of the dichroic properties of these fibres when dyed with certain selected dyestuffs. This gives a quantitative expression for the degree of orientation of the micelles in the fibres, which agrees with the results deduced from the X-ray diagrams of such

The method, it was claimed, is simpler and less costly than that of X-rays and gives results which are more readily expressed quantitatively. The implications of this work, as far as it affects the depth and shade of dyed fibres of various types, were dealt with, and also the relation of the quantitative value of the orientation to the swelling and tensile properties of these fibres.

Wages in Dyeing Industry

EMPLOYERS in the dyeing and finishing industry of Yorkshire, Lancashire, Cheshire, Derbyshire, and parts of Scotlandthrough the Allied Association of Bleachers, Dyers, Printers, and Finishers—propose to seek some relief in respect of production costs in what they describe as the "unprecedented trade depression" by means of a reduction in the wages of their operatives. Some 80,000 workers will be affected, and a meeting of the full executive committees of the joint dyers trade unions is to be held in Bradford to-day (Saturday), to consider the proposals and their own course of action.

This is the first official indication that has been given of the probable action of the employers. The representatives of the employers and the trade unions last met jointly in Manchester on Monday, and, it is understood, a point was then reached where it became evident that the means by which the employers proposed to secure the relief they sought was by a

wage reduction.

The last general wages discussions in the dyeing and finishing sections of the textile industry took place in 1928, when an agreement was reached, to be determined by three months' notice in writing by either side.

Dyes and Textiles Notes on Current Researches Uses of Urea in Printing

UREA is an organic substance which appears to be finding increased use in the textile industry for various purposes, and it has the advantage of being inexpensive. It will be remembered that comparatively recently this substance has been found useful for delustring cellulose acetate rayon, this action being due no doubt to the slight solvent power which it may exert on the rayon. Urea now proves to be a valuable assistant (E.P. 318,469) in obtaining deeper and faster printed colour effects on cotton and other cellulose fibres.

In printing cotton fabrics with mordant dyes and then steaming, it is found that there is a tendency for the dyes to bleed into the adjacent non-printed parts, and if these be white then the staining thus produced is very objectionable. If, however, urea is added to the printing paste, this bleeding is largely prevented. Moreover, the printed parts are not only faster to water, they are also faster to soaping. The urea assists fixation of the dyes employed such that the resulting shades are considerably deeper. About 5 per cent. of urea is suitable for adding to the printing paste, and the following is an example of a paste satisfactory for printing:—

	grams
Chromazurin E	20
Urea	50
Hot water	230
Gum tragacanth thickening	600
Chromium acetate solution of 20 Be	100

Strengthening Regenerated Cellulose Rayons

E.P. 317,085 claims a process for increasing the tensile strength and extensibility of such rayons as viscose and cuprammonium by impregnating them with a solution of glyoxal and then drying at a moderate temperature. Such a process is reminiscent of earlier processes which were never brought to practical success, and which involved treatment of viscose rayon with formaldehyde for the purpose of increasing its wet strength.

The strengthening process now described appears to be comparatively simple, such that no serious practical difficulties are likely to arise in carrying it out on a large scale. Thus in the case of cuprammonium rayon it is merely necessary to impregnate with a 2 per cent. solution of glyoxal, then squeeze out excess of liquor and dry at 50–60°C. The resulting rayon has about 25 per cent. increased tensile strength, and is about 50 per cent. more extensible. Whilst increased strength is, of course, of the utmost value it is somewhat doubtful if the greater extensibility is equally advantageous unless it is accompanied by a corresponding increased elasticity; in knitting rayon goods it is not desirable that the yarn should stretch easily unless it can quickly return completely to its original length.

Instead of glyoxal itself, it is satisfactory to employ substances which readily yield glyoxal, such as tetra-methylal-glyoxal and n-tetra-butylalgloyxal during the treatment.

Dyeing Saponified Cellulose Acetate Rayon

The possibilities of partially saponified cellulose acetate rayon have within recent months become of much greater interest to dyers and finishers than hitherto, and it appears that by means of such rayon it will be possible to produce improved woven and coloured textile materials. In this manner cellulose acetate may thus show itself to have properties more valuable than those of viscose rayon since this, as is well known, cannot be saponified.

In E.P. 339,997 attention is drawn to the fact that if the degree of saponification is not too great then the rayon has no affinity for cotton dyes and retains a useful affinity for cellulose acetate dyes. It is thus possible to give the rayon new physical properties, such as greater resistance to creasing whilst in a wet condition and greater moisture absorptive power, without loss of its unique dyeing properties.

According to the patent it is possible to saponify up to 56 per cent. of the acetyl groups without conferring on the rayon an affinity for direct dyes, but in practice it is likely that a much lower degree of saponification would be effected since saponification results in a loss of weight.

Dyestuffs Market Reports (From Our Correspondents)

Lancashire

A number of independent reports agree that during the last week there has been a serious falling-off in business, so that in Lancashire at least the sales of dyestuffs and auxiliary products for the trade has fallen to a lower level than perhaps at any previous time.

No doubt one of the most important factors contributing to this state of affairs is the dispute and lockout in the weaving section of the cotton industry. The shortage of goods for bleaching, dyeing and printing has already been felt acutely, and several bleach and dye works have closed down indefinitely; whilst it is reported that some of the larger print works have gone on short time. Under these conditions, it is difficult to estimate the nature and extent of the changes brought about as a result of the controversy and discussion on the Dyestuffs (Import Regulation) Act.

It appears to be generally accepted that applications by users in this country for the import of foreign dyestuffs will be considered favourably, and licences granted, on price grounds, if the price of the foreign product is lower than that at which the British manufacturer is prepared to supply.

It is reported that I.C.I. Ltd., have already reduced prices in certain instances to meet cases of this kind, but the policy of lower prices over a very wide range, initiated by this company a year ago, has naturally had the result of giving a much less spectacular appearance to recent reductions. It is generally agreed that prices in England to-day are not higher than anywhere on the Continent, with the possible exception of Italy, and, if the comparison be limited to certain countries, the price level here is appreciably lower.

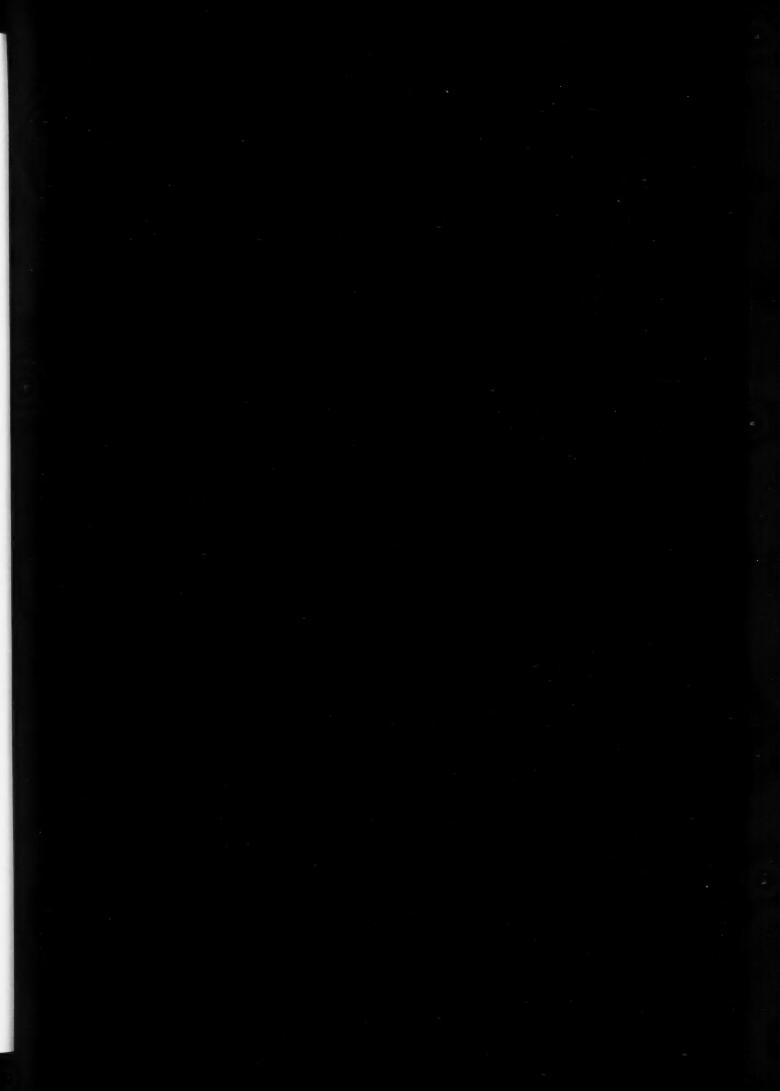
In spite of bad trade (or perhaps because of it), there is a great deal of activity in development work, and in the production of dyestuffs either entirely new or not previously made in this country. In particular, there is a great deal of activity in the discovery, invention and production of new products to be used in bleaching, dyeing and printing—as, for example, scouring and wetting agents, softening and finishing materials, products for sizing and desizing, etc. This sort of activity is naturally not confined to British makers: both the I.G. in Germany and several of the Swiss firms seem to be devoting more attention to the marketing of ancillary products for the textile industries. The progress that has been made, for example, in the production of substances capable of producing permanent emulsions of oils, fats and waxes, and of substances capable of exerting a powerful scouring and cleansing action with hard waters, and even in the presence of acids, is most remarkable.

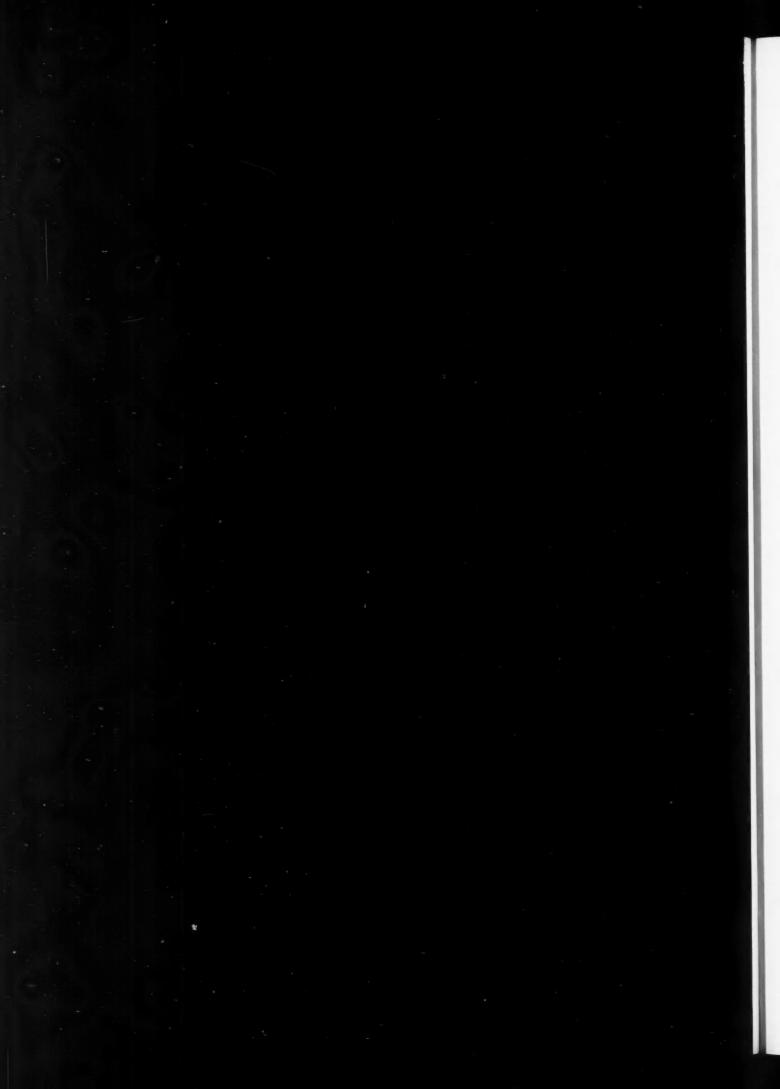
Scotland

The Scottish tweed trade have arranged to send a delegation to Canada and U.S.A. either this month or in March. These are already good markets for the Scottish tweeds, but it is felt that the appreciation already accorded to these could be extended to the many other kinds of cloth which the trade makes, especially the finer cloths which are not anything like so well known as the rough tweeds. The arrangements have been made after discussions between the National Association of Scottish Woollen Manufacturers and the Department of Overseas Trade, and an official of the latter is to accompany the mission. The view is that a representative and more or less official delegation from the trade may be able to obtain bigger results than numbers of private firms acting individually and, besides undertaking propaganda work, the intention is to gain as much information as possible as to improvements the trade can make in directions such as modern methods of marketing.

Meanwhile at home, while the tweed factories are still short of work, there has been a slight improvement and orders for Europe are on the increase.

Dyestuff orders were very good in the first three weeks of the year, but there has been a falling-off to lower levels again since. Direct colours particularly were selling well. Dyers in Scotland are, however, finding times difficult with the cut prices ruling at present, and for orders for the south the small extra cost of carriage is quite a substantial handicap.





Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

New I.C.I. Colours

Three new colours are announced by Imperial Chemical Industries, Ltd., and very beautiful shades they are—Chlorazol Fast Orange ERS, distinguished for its deep and brilliant tones; Caledon Green 2BS Paste, a very satisfying colour whose shades may be considerably varied with the percentage of paste used; and Caledon Grey 2RDS Paste, a particularly delicate tone shown on cotton yarn, cotton piece, and viscose yarn.

Chlorazol Fast Orange ERS

Chlorazol Fast Orange ERS, an addition to the I.C.I. range of Chlorazol colours, is very closely related in dyeing and fastness properties to Chlorazol Fast Orange AGS, but is considerably redder in shade. These two colours in combination enable a wide range of orange shades to be produced. This colour is suitable for dyeing all types of cotton materials, but is of special interest for piece dyeing. It possesses very good all round fastness properties, including excellent fastness to light, being in this respect one of the fastest of the direct cotton colours. It possesses excellent dyeing properties and is very suitable for machine dyeing. Dyed from a neutral dyebath, the affinity for animal fibres is very low, and it is therefore of interest for covering the cotton in cotton-wool or cottonsilk union materials. It is suitable for dyeing viscose artificial silk and natural silk, the latter from a bath acidified with formic acid. It is also suitable for dyeing paper, leather, taga! and wood chip, particularly in those cases where light-fastness is of importance. This colour is of interest in silk printing as a ground shade for the production of white or coloured discharge effects. Chlorazol Fast Orange ERS possesses good affinity for the cotton fibre but is somewhat slow in speed of dyeing. maximum affinity is obtained at or near the boil and with the recommended amounts of salt. This colour does not "boil off" the fibre at high temperatures.

A New Vat Grey

Caledon Grey 2RDS Paste, an important addition to the well-known range of Caledon colours, fills a distinct gap in the vat colour range, being one of the few fast-to-light homogeneous vat greys. This new product is suitable for application on all classes of cotton materials where fastness to light and washing are required. It possesses good solubility and levelling power and may therefore be applied in circulating machines. Caledon Grey 2RDS is suitable for the dyeing of silk and linen and, by virtue of its superior level dyeing properties, is of great interest to dyers of viscose. It is dyed according to the particulars set out under group III in the pattern card "Caledon Colours on Cotton." Process II may be used as an alternative method. Caledon Grey 2RDS is not particularly suitable for application by direct printing, but will be of interest to printers on account of its being dischargeable by the formosul method.

Caledon Green 2BS Paste

This is an addition to the I.C.I. range of Caledon colours, and is suitable for the dyeing of all classes of cotton yarn either in machines or in the open beck. It is particularly suitable for the dyeing of piece goods, especially where full shades of excellent fastness to light and washing are required at a minimum cost. It is also suitable for application on viscose, linen, and silk. The colour is not suitable for

shades that are subsequently to be bleached. Dyeing is conducted according to the particulars set out under group I in the pattern card "Caledon Colours on Cotton."

Dyestuff Licences in February

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 485, of which 407 were from merchants or importers. To these should be added 29 cases outstanding on January 31, 1931, making a total for the month of 514. These were dealt with as follows:—Granted, 462 (of which 449 were dealt with within 7 days of receipt); referred to British makers of similar products, 52 (of which 38 were dealt with within 7 days of receipt). Of the total of 514 applications received, 487, or 95 per cent. were dealt with within 7 days of receipt.

Ultramarine Blue Tariff

Of the total amount of ultramarine blue imported into the United States, 85 per cent. is supplied by Great Britain, namely, 584,556 lb., valued at 70,296 dollars in 1929. The recent decision of the United States Tariff Commission is therefore a matter of interest to British exporters. The present rates of duty under the Tariff Act of 1930 are 3 cents per lb., if valued at 10 cents or less per lb., and 4 cents per lb. if valued at more than 10 cents per lb. on ultramarine blue, dry, in pulp, or ground in or mixed with oil or water, wash and all other blues containing ultramarine blue. On the facts obtained in the investigation the Commission has decided against any change in the existing rates.

The costs of production of ultramarine blue produced in the United States were \$0.1214 per lb. for the grades selling from 12 to 16 cents per lb., and \$0.1736 per lb. for the grades selling for 17 cents per lb. and over, for the period covered by the investigation. The corresponding costs of production in the principal competing country as evidenced by invoice prices were \$0.0872 per lb. and \$0.1263 per lb., respectively. The cost of transportation and other delivery charges of ultramarine blue from the centres of domestic production to the principal market in the United States was \$0.0021 per lb. during 1929, and the corresponding cost from the centres of production in the principal competing country to the same market was \$0.0086 per lb.

Cost of Production

The total cost of production of ultramarine blue in the United States, including transportation and other delivery costs to the principal market, were thus \$0.1235 per lb. for grades selling from 12 to 16 cents per lb., and \$0.1757 per lb. for the grades selling at more than 17 cents per lb.; the corresponding foreign costs of ultramarine blue were \$0.0958 per lb. and \$0.1349 per lb.; and the differences in such costs were \$0.0277 per lb. and \$0.0408 per lb., respectively.

The commission finds it shown by the investigation that the duties expressly fixed by statute on ultramarine blue, equalise the differences in the costs of production, including transportation and delivery to the principal market in the United States of the domestic article and the like or similar

foreign article.

Explosion in Acid Mixing Plant

Official Report on Castleford Disaster

The circumstances attending an explosion in an acid mixing plant that occurred on July 4, 1930, at the works of Hickson and Partners, Ltd., of Castleford, Yorkshire, have now been investigated by Messrs. S. H. Newman, engineering inspector of factories, and H. E. Watts, inspector of explosives, whose report is published by the Home Office (H.M. Stationery Office, od.). The report shows the explosion to have been due to an excessive quantity of nitro body being carried from an acid storage tank to the acid mixer. The following extracts are taken from the document:

The normal products of manufacture were pure benzene, toluene and xylene, the chlorinated and the mono- and dinitrated derivaties of these hydrocarbons, di-nitro-phenol (wet), di-chlor-aniline, toluidines, xylidine, benzidine, sulphur black and brown, and the magenta products of the Rosaniline The factory contained the following plants, and the relevant acid storage accommodation:—(a) Plant for the distillation of benzene, toluene, etc.; (b) sulphuric acid chamber plant; (c) sulphuric acid concentration plant (cascade system); (d) nitration plant for the production of mono-nitro, and di-nitro derivatives; (e) di-nitro-phenol plant; (f) plant for the manufacture of dyes, such as sulphur (g) acid mixing plant. In addition there was a nitric acid plant for the production of nitric acid from nitrate

of soda, but this was no longer in use.

The Acid Mixing Plant.—This plant was used for mixing the requisite quantities of nitric and sulphuric acids for the various nitration processes. The acid mixing plant consisted of two cylindrical steel tanks, one of which was under repair and not in use. The other mixing tank was about 8 ft. in diameter and 8 ft. high, and was carried by two girders resting on a 6 in. concrete platform, which was supported by brick or concrete piers about 3 ft. high standing in a pit with a concrete floor. The bottom of this pit was about 2 ft. below the ground level. This tank was fitted with a fixed steel cover 3 in. thick in which a manhole 14 in. in diameter was provided, and the stirring gear consisted of a three-blade stirrer rotated at about 40 revolutions per minute. There were no cooling coils in the mixer, neither was there any external cooling.

Sulphuric Acid.—The sulphuric acid used for making mixed acid consisted generally of B.O.V. (brown oil of vitriol containing about 80 per cent. H₂SO₄) and of D.O.V. (double oil of vitriol containing about 95 per cent. H₂SO₄), but on a few occasions the unconcentrated waste acid from the nitration processes had been used. The relative quantities of B.O.V. and D.O.V. used depended on the water content of the mixed acid required. Thus, if the water content of the mixed acid required was high, the maximum quantity of B.O.V. would be used for the mixing, but if the water content of the mixed acid required was low, then the requisite quantity of D.O.V. would be used in conjunction with B.O.V. in order to bring the water content of the mixed acid to that desired.

The sulphuric acid was generally supplied to the mixer from the following vessels:—(a) A steel storage boiler shell sunk in a brick pit used for the storage of B.O.V.; (b) a steel storage boiler shell sunk in a brick pit used for the storage of D.O.V.;

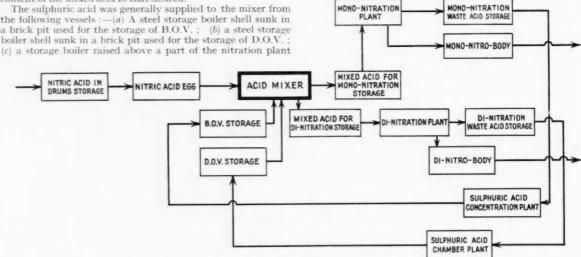
used for the storage of D.O.V. and situated approximately at the point 20 on the plan. Two of the storage boilers were provided with a common line to the mixer, and their contents were transferred to the mixer by compressed air. In addition to this, the contents of these two storage boilers could be interchanged if required. The other storage boiler had its own line to the mixer, and the acid was run by gravity from it

to the mixer. The mixtures were situated in the open.

Nitric Acid.—Nitric acid was supplied to the mixing tank by means of a cast-iron egg sunk in a pit which delivered through a lead pipe at the top of the mixer. This egg consisted of a heavy vessel of about 300 gallons capacity, and its walls were about $2\frac{1}{2}$ in. thick. The nitric acid was imported in aluminium lined steel drums fitted with a special type of raised hexagonal bung. These drums were rolled up on to a wooden track close to the egg, and the requisite quantity of acid was siphoned from them into an open lead sight box measuring 12 in. square attached to the egg. This acid was then blown by compressed air from the egg into the mixing tank. mixing tank was fitted with a pipe to the mixed acid storage boilers. The acid, when mixed, was run by gravity down this pipe line to one of the storage boilers.

The normal method of procedure in carrying out a mixing of acid for mono-nitration is as follows:--A charge of B.O. is first blown into the mixer from the acid storage boiler. acid in the mixer is then sampled and examined in the laboratory to ascertain whether it is of the requisite strength; if it is below this strength the calculated quantity of D.O.V. is then blown or run into the mixer to bring up the strength of the acid to that required. When this has been done, the necessary quantity of nitric acid (97-98 per cent.) is blown into the mixer, and the two acids are mixed by stirring. After mixing is completed, the mixed acid is then run into a mixed acid storage boiler. This plant had been in operation since 1915, and acid mixing had been carried out about three times a The operation of mixing usually took about six hours.

Acid Storage and Disposal. Nitric acid was stored in aluminium-lined steel drums as stated above and contained from 97 to 98 per cent. $\rm HNO_3$. Waste acid from the process of making di-nitro compounds was nearly always sent to the Glover tower of the chamber plant where the acid was de-



FLOW SHEET, SHOWING THE NORMAL CYCLE OF OPERATIONS.

nitrated, and the residual nitric and nitrous acids left in the acid after the process of di-nitration were removed, but occasionally it was used for the manufacture of mixed acid for making mono-nitro compounds. Waste acid from the process of making mono-nitro compounds was nearly always sent to the cascades to be concentrated, but occasionally it was used in conjunction with either B.O.V. or D.O.V. for the manufacture of mixed acid for making mono-nitro compounds. The waste acids from both nitration processes always contain a certain amount of nitro-body (mono-nitro compound or di-nitro compound or a mixture of them), and this on standing separates out as an oil on the top of the acid.

Cause of the Accident

It seems quite clear from the statements of various eyewitnesses that after a process worker commenced to blow nitric acid into the mixer copious brown fumes were seen round the mixer, then flame was seen to come from the manhole of the mixer, and subsequently an explosion occurred. These facts suggest that an uncontrolled nitration, which progressed to explosive decomposition, took place in the acid Normally the process of mixing nitric and sulphuric acids is a safe one, and in order to produce the effect described above, it would be necessary for some organic matter to be present in the mixer, and thus convert the harmless process of acid mixing into the process of nitration which becomes dangerous if uncontrolled. It was not possible to check the various pipe connections to the mixer as they were destroyed, but it appears that there were only three inlets to it, and these were the supply pipe from the adjacent nitric acid egg. a common pipe from sulphuric acid storage boilers and a pipe from a third sulphuric acid storage boiler. The only delivery pipe out of the mixer was to the mixed acid storage boilers.

We have considered the possibility of organic matter having been deliberately placed in the mixer, and we think this may be ruled out. It would appear, therefore, that organic matter could only have been introduced into the mixer in one of the following ways:—Blown in from the nitric acid egg with the nitric acid, or run into the mixer from a sulphuric acid storage boiler, or blown in from another sulphuric acid storage boiler.

Conclusions

It seems quite clear from the evidence of various witnesses that brown fumes and then flames were seen to come from the mixer in use, and subsequently an explosion occurred. Experiments carried out at Woolwich showed that, when the nitrobody was treated with some of the sulphuric acid taken from a storage boiler and strong nitric acid, brown fumes were given off with the evolution of heat which caused the nitric acid to boil, and the nitric acid dissolved the nitro-body and formed a layer above the sulphuric acid.

These experiments were conducted on a small scale, and if similar conditions existed on a large scale in the acid mixer, it is possible that considerable local heating would occur, which may have produced spontaneous ignition within the mixer, or some of the contents of the mixer may have boiled over, and come in contact with some organic matter, and led to the subsequent fire. A mixture of the nitro-body and strong nitric acid when mixed in certain proportions was found to burn fiercely, and it is possible that the confinement given by the steel cover on the mixer was sufficient to enable the mixture to burn to explosion.

Observations and Recommendations

The collection of a certain amount of nitro-body in the waste acid storage tanks is inevitable, and it should be the first care of the factory management to see that no undue accumulation of this body occurs. In this case the normal procedure of sampling does not appear to have been followed, and it is just possible that if proper sampling had been carried out, the presence of the nitro-body in the acid mixer might have been detected.

Cases of fires in nitrators are known to have occurred, but these have not progressed to explosion. This is probably due to the fact that in a nitrator the reaction is controlled both by the rate of inflow of the ingredients, and by cooling, either by means of a water jacket or a cooling coil inside the nitrator, and in the case of di- or tri-nitration the mono-nitro-compound is added to a mixture of nitric and sulphuric acids.

The process of mixing clean sulphuric acid 80 per cent. with strong nitric acid is not a dangerous one, but if nitric acid is added to waste acid recovered from nitration processes an element of danger is introduced, by reason of the presence of some nitro-body in the waste acid, which may be further nitrated by the nitric acid.

If it is desired to make mixed acid by using waste acid from a nitration process, and this contains nitro-body, then the addition of the requisite quantity of nitric acid should be regarded as a nitration process and appropriate precautions taken, namely:—(I) The nitro-body which collects in the nitration waste acid storage tanks should be removed regularly, and not allowed to accumulate. (2) The vessel in which the operation of mixing takes place should be fitted with efficient stirring gear, and also adequate means of cooling by the provision of cooling coils or water jacket or both. (3) No waste acid should be stored, and no nitro-body allowed to collect in a tank which supplies sulphuric acid to a mixer unprovided with any means of cooling. (4) In all such mixing plant the construction should be such that wood and other oxidisable material should be excluded. If these precautions are adopted, the process of acid mixing in which waste acid from nitration is present should be safe.

The waste acid from the process of mononitration was generally sent direct to the concentrators. If the waste acid were denitrated in the ordinary way instead of being sent direct to the concentration plant, this would enable a further portion of the nitro-body, which is held in the acid, to be separated out, as the steam passing up the denitrating column would volatise a portion of the nitro-body and this would be collected, together with the nitrous and nitric acids liberated from the waste acid. The denitrated sulphuric acid is weaker in strength than the original feed acid to the denitrators (owing to the condensation of the steam injected at the bottom of the column) and a further quantity of nitro-body would separate from the denitrated acid. This would diminish the quantity of nitro-body which would be sent to This would the cascades, and thus lessen the risk of fire on this plant. The lead work on this plant would not become corroded so quickly owing to the absence of nitrous and nitric acids, and the scrubbers could be kept clear of the corresponding amount of nitro-body. This precaution, although not essential, is certainly one which would free the feed acid to the concentrators from as much nitro-body as possible.

Light Colour Change
Important Discovery by Hindu Nobel Prize Winner

The discovery that light of a single colour, or wave-length, shining on certain transparent substances, is partly changed to other colours is regarded as the greatest accomplishment so far of Sir Chandrasekhara Venkata Raman, the Hindu scientist, who hast been awarded the Nobel Prize in physics. Named after its discoverer, this is now known as the Raman effect, and it was first announced in the spring of 1928. Research laboratories in all parts of the world are now engaged in studying it, because it has opened up an entirely new field in the study of molecular structure.

One of the first scientists to verify it, apart from Sir Chandrasekhara's own laboratory, was Dr. R. W. Wood, of The Johns Hopkins University. Working at the private laboratory of Alfred L. Loomis, Tuxedo Park, N.Y., Professor Wood considerably improved the original apparatus of the Indian scientist and detected the effect in the summer of 1928. The Raman effect occurs when monochromatic light (which is light of a single colour or wave-length) shines on transparent substances, such as quartz, chloroform, or water. Generally a mercury arc is used as the light source. The light that is scattered by the transparent material is mostly of the same colour as that of the light illuminating it. The spectroscope, the instrument that analyses light, however, shows that part of this light is changed to wave-lengths a little longer or shorter than that of the source. That is, part of the light is either more reddish or more bluish. On the spectrum photo. graphs the result is a heavy line, representing the main colourattended on either side by narrower and fainter lines. fainter lines on one side are arranged the same way as those on the other, except that they are reversed, as if reflected in a mirror, the centre heavy line being the mirror. Sir Chandrasekhara, in his first experiments, found only a single and very faint line on the high frequency, or blue, side of the main one; but with the improved apparatus Professor Wood found groups of nearly equal strength on each side.

Basic Intermediates for Dyestuffs: No. XLI.—Brominated Compounds as Dyestuffs Intermediates

By "Consultant"

Although the matter is very seldom mentioned in the standard textbooks, and although most dyestuffs manufacturers try to replace it by chlorine wherever possible, bromine occupies a place in the manufacture of quite a number of dyes and their intermediates, of some considerable importance. From an historical standpoint it is an acknowledged fact that without the use of bromine our knowledge of the fundamental processes of organic chemistry would not have proceeded at anything like the accomplished rate; and among the classical dyestuffs syntheses bromo-compounds figure very widely. Two instances from the syntheses of indigo would prove this point, namely the use by Baeyer of the ω -bromo-aminoacetophenone (I) for the constitutional synthesis of indigo by

Salmony and Simonis from the condensation product of dibrommaleic acid and aniline (3 and 4). Such examples could be multiplied without end. There are two distinct methods by which bromination compounds can be made to serve the dyestuffs industry, namely, methods in which the bromine serves as the connecting link between the two combining molecules and is eliminated, not appearing in the final compound; and methods in which one or more bromine atoms forms an integral part of the final molecule.

The Bromine Derivatives of the Indigo Series

Quite a number of the bromine derivatives of the indigo series have been proposed at one time or another for use in the dyestuffs industry. There are, of course, two methods by which the desired bromine atoms can be introduced into the molecule of indigo. In the first method the direct bromination of the complete indigo molecule is effected. This process lays numerous restrictions on the number and position of the entering bromine atoms, and where the effect of these restrictions is undesirable, recourse is had to the second method, namely, the use in the indigo synthesis of intermediates which already contain the bromine, and which do not lose the halogen atoms during conversion into a substituted indigo.

In direct bromination, the reaction, as far as indigo is concerned, is much smoother than with direct chlorination, and when a cold solution of bromine in acetic acid is added to a suspension of indigo in the same medium the monobrom derivative may be prepared. In actual fact the 5-monobromindigo is [produced almost exclusively (5). No other monobromindigo has been prepared in any quantity.

although there would be no difficulty in doing so should the need arise. The monobrom derivative just referred to has a redder shade than the unsubstituted parent compound, and has been marketed under the names Indigo R. and Indigo pure R

The four symmetrical dibromindigos have all been prepared, and it is a matter of some interest to note that the 6:61-dibromindigo is of some considerable historical interest, being the purple of the Ancients, the so-called "Tyrian Purple." Various shellfish contain certain compounds, white in themselves, but which, if allowed to stand exposed to sunlight, give rise to a deep reddish violet colour. The application of extracts of such molluses to fabrics, afterwards exposed to the sun, constituted a method of purple dyeing which was well known to the Ancients and which by modification of the various ground colours, applied before this process, could be made to yield almost any colour from crimson to the blue-violet colour known as "jacinth." The process was not unknown in these islands, since William Cole, of Bristol, in 1685 details an account of an Irishman who made a living by marking linen with names and initials in a deep purple, by means of the secretion of the glands of a certain shellfish. The substance has served many chemists as a subject of investigation. Schunk in 1879 made a detailed examination of the mollusc Purpura capillus gathered from the shore at Hastings and able by dissection and chemical purification to extract seven milligrams of the crystalline dye from 400 shellfish. Friedländer dissected out the glands from 12,000 specimens of Murex Brandaris, and isolated 1'4 grams of the pure recrystallised dye, which he then proved to be 6:6'-dibromo indigo (6). It has been prepared synthetically by Sachs and Kempf, and since then by the condensation of p-bromo-onitrobenzaldehyde with acetone in the presence of an alkali. This gives the compound 4-bromo-2-nitrophenyllactic ketone (7), which may be converted into the symmetrical 6:61-dibromindigo by an alkali fusion.

The dibromindigo which is of paramount commercial importance is the 5:5¹-dibromo derivative obtained by direct bromination of indigo in cold acetic acid. Owing to the coldness of the bromination liquid complete dibromination cannot be attained without risk of the simultaneous production of the tri- and tetrabromo derivatives, so that the commercial dibromindigo usually contains about 10 per cent. of the monobrom derivative. This mixture was usually known as Indigo RR, Indigo RB or Indigo RBN, but is not widely used at present. The other dibromindigos, namely, the 4:4¹- and 7:7¹- derivatives, have been obtained by starting with a suitably brominated intermediate. Thus, in the case of the 4:4¹- derivative 4-bromo-o-toluidine (8) is converted into the corresponding p-bromo-o-amino benzoic acid (9) by the conventional steps, and then by the action of chloracetic

acid this compound is transformed to the corresponding derivative of phenylglycine (10) which on alkali fusion yields the 4-bromo indoxyl (11) necessary for the production of 4:41dibromindigo. The 7:7¹-derivative is prepared by a slightly different process, namely, the conversion of o-bromaniline (12) into its condensation products with oxanilide (13) which may

be chlorinated and converted into 7-bromisatin (14) via the di-acid chloride. The dibromindigo may then be obtained via the 7-bromisatin chloride (15).

Higher Brominated Indigos

The higher brominated indigos are of considerable value as vat dyes. It is a remarkable fact that although chlorination of indigo has but little effect on the shade of the dye, affecting only its brilliance, the introduction of the heavier bromine atom leads to a deepening of the blue tone, leading in extreme cases to a greenish colour, an effect which is intensified when bromine is replaced by iodine. When the direct bromination of indigo is carried out progressively, three distinct stages are recognised. Firstly the mono- and dibromo stages, effected by bromine in acetic acid; secondly, the bromination at 200° C. in nitrobenzene which produces the tri- and tetrabromo

compounds; and finally, bromination in the presence of chlorsulphonic acid when compounds up to the hexabromo stage are obtained. The following compounds have been distinguished:—

i 5:7:51-Tribromindigo

Known commercially as Indigo 2B or Helindone Blue 2B and not of great importance.

ii 5:7:51:71 Tetrabromindigo

Durindone Blue. Previously known as Brilliant Indigo 4B. Ciba Blue 2B, etc.

iii 4:5:7¹5¹:7¹-Pentabromindigo A mixture of these two subiv 4:5:7:4¹:5¹:7¹-Hexabromindigo stances is known as Ciba Blue G or Indigo 6B.

The drawback of the higher brominated indigos lies in the fact that bromination decreases the solubility of the leuco compound. The actual practical details of the preparation of these compounds are so stereotyped that one example will easily serve for the whole series. The most valued compound is the tetrabrom compound, which is obtained by bromination of indigo in nitrobenzene. The dry indigo (56 lb.) is milled with nitrobenzene until a paste is obtained which readily yields an even suspension when diluted with further nitrobenzene. In all about 50 gallons of nitrobenzene are required. The suspension is placed in a digester capable of withstanding a slight pressure (30-50 lb./sq. in.) and capable of being stirred and heated to 225° C. The bromine is added (200 lb.) through a suitable man-hole in about five lots and the mixture kept at 225° C. for two hours after the last addition of bromine. The reaction is completed by gently boiling the nitrobenzene for another two hours, after which the batch is cooled off and the filtered batch steamed to remove nitrobenzene, dried and milled to a paste.

Dyes and Dyeing: Technical Progress in 1930.—(II) By L. J. Hooley

Anthraquinone Dyes

The treatment of dianthrimide derivatives, especially substituted ones, with ring-closing agents, particularly sulphuric acid or aluminium chloride in pyridine, has been further exploited. As an example of a complex derivative obtainable in this way the body formulated below may be given.

The dipyrazolanthrones still serve as a source of red and other vat dyes and there is now a tendency to build up more complex and unsymmetrical molecules by condensing a pyrazolanthrone with another anthraquinone derivative so substituted that ring-closure to a body which is half a pyrazolanthrone and half an indanthrone or dibenzanthrone, or acridone can take place. (B.P. 332,316, I.G.F.A.-G). With regard to the dibenzpyrenequinones, anthanthrones and naphthadianthrones little need be said but that development is following traditional lines for these types of polycyclic compounds.

An interesting class is the naphthoylene-arylimidazoles. Starting with the synthesis of new bodies of this type by condensing perylene tetracarboxylic acid with o-arylene diamines, the reaction has been extended first to naphthalene tetracarboxylic acid and then to other bodies containing two carboxylic acid groups in *peri* positions to each other, such as benzanthrone dicarboxylic acids, all of which can be regarded as substituted naphthalene 1:8 dicarboxylic acids. Bodies of this constitution can be noticed not only among the vats but also the azo, acid and acetyl silk colours. It will be seen that they are not necessarily anthracene derivatives.

Indigo Dyes

Many of the patents are as usual concerned with the synthesis of the necessary substituted aryl carboxylic acids as intermediates, especially for the thioindigo colours. The possible ways of synthesising these, at any rate, from the theoretical point of view are large and most of the new methods are only novel in detail. Unusual hydrolysing agents are aromatic sulphonic acids which in B.P. 310,757 (I.G.F.A-G.) are used for the hydrolysis of o-cyanothioglycollic acids. The bromination of these same o-cyanothioglycollic acids is described in B.P. 324,484 (I.G.F.A-G). o-Cyano-sulphonyl chlorides are used as starting points in B.P. 319,075 (I.G.F.A-G.)

Dyes slightly faster to light and almost as bright as the known 6:6¹-dihalogen-4:4¹-dialkyl-thioindigos are obtained by condensing a '6-halogeno-3-oxythionaphthene with a 4-methyl-6-halogenthionaphthene. o-Aminoarylthioglycollic acids can be converted to dyestuffs on the fibre with ferricyanides. Other new products suitable for transformation to dyestuffs on the fibre are those obtained by condensing indigo with m-chloro-sulphonyl benzoic acid, condensation taking place in the NH groups through the carboxylic acid instead of the sulphonic acid as might be expected.

Triarylmethane and Basic Dyes

An interesting variation in the synthesis of lakes of triarylmethane colours from complex acids such as phosphotungstomolybdic consists in treating the leuco compound of the dyestuffs with the complex acid and an oxidising agent; for example, leuco Malachite Green is treated in hydrochloric acid solution with potassium permanganate and sodium phosphotungstomolybdate. In addition to eliminating one stage of the normal process the shades are sometimes better. A dispersing agent such as formaldehyde-naphthalene sulphonic acid may conveniently be added (B.P. 330,229 I.C.I., F. W. Linch, E. H. Rodd and H. K. Frew).

Dyes of considerable complexity can be obtained by the interaction of prechromed triarylmethane dyes with prechromed azo dyes, for which a high fastness to light is claimed (B.P. 296,310, S.C.I.B.).

The influence of substituents on the fastness and shade of triarylmethane dyes can be seen in two British patents; in B.P. 332,560 the use of complex amines obtained by the action of phenylenthyl halides on primary or secondary arylamines in the production of triphenylmethane dyes by condensation with aldehydes, etc., gives shades rather more reddish than the corresponding products from simpler amines. Further, in B.P. 324,966 superior light fastness is claimed for the dyestuffs obtained by condensing non-sulphonated arylamines with o-sulpho-benzaldehyde (I.G.F.A.-G.).

Among basic colours a few miscellaneous results are to be reported, these including some new complex phenylnaphthosafranines (B.P. 284,615, 297,441, 300,549, J. R. Geigy); new safranines (B.P. 300,178 I.G.F A-G.); and phenylnaphthazines obtained by conedensing a 3-arylamino-1:8-naphthasultam compound with, for example, a nitrosodimethylaniline hydrochloride to give, for example, a red-violet as shown

below.

Two or three methods for the production of diamines suitable for dyeing hair may be mentioned. H. Meyer (Chem.-Ztg., 1929, 756) recommends the use of salts of diamines with carboxylic acids, as these acids only form mono-acid salts, and mono salts are superior to the di-salts, and do not combine with butyric acid and give salts which close the skin pores. A. Jinno (B.P. 322,972) recommends mixing the diamine with tannic acid and starch, boiling with water and pasting with hydrogen peroxide, the tannate of the base is harmless to the skin and the hydrogen peroxide serves as a gradual oxidising agent.

New basic dyes of the Rhodamine series can be synthesised by condensing 2-amino-m-4-xylenol or its acetyl derivative with a 2-hydroxybenzoylbenzoic acid containing an alkylamino group in the 4-position, and esterifying the carbonyl group after condensation (I.C.I. and M. Wyler, B.P. 333,016).

Among the new dyes from indoline bases may be mentioned the greenish-yellow obtained by treating 2-methylene-1:3:3-trimethylindoline with sodium nitrite in acetic anhydride (G.P. 459,616, I.G.F.A.-G.). A much redder shade can be obtained in the manufacture of Acridine Orange by doubling the quantity of nitric acid in the nitration of tetra-methyl-diamino-diphenylmethane (B.P. 316,315, Durand and Hugue-

The solubility conferring effect of the pyridacetyl group can be seen in the very soluble metal compounds of o-nitroso hydroxy dyes obtained by nitrosating pyridacetylaminonaphthols and in the strongly basic azo dyes obtained from unsulphonated azo dyes, containing primary or secondary amino groups by treating with chloroacetyl chloride and then with pyridine (J. R. Geigy, B.P. 305,648 and 295,032).

(To be continued.)

Dyestuffs Market Reports (From Our Correspondents) Lancashire

The British Industries Fair has come and gone. As a demonstration of the quality of the work that the textile industries are capable of turning out, it has most certainly achieved its object. But it still remains to be seen whether the stimulus to trade will be anything but a mere flash in the pan. Simultaneously with the general chorus of acclamation as to the results obtained, cotton went up in price, and other industrial securities rose in sympathy.

The first news of the concordat between the Viceroy and the Congress party in India sent a further wave of optimism through the cotton trade, but further developments seem to have shown that the rejoicings were somewhat premature. In spite of the great industrial depression, the effects of which have fallen with especial severity on the cotton and woollen industries, the total turnover in the world's dyestuff trade

has been very well maintained during the last twelve months. Reports just issued show that the imports of British dyestuffs into India actually showed a slight increase over 1929, as has the small British export to the U.S.A., to Belgium, and to Italy. The money value of the dyestuffs exported during January of this year was £81,000, as against only £56,000 in January of last year, and £86,000 in 1929.

With regard to the new dyestuffs, the outstanding feature of the month has been the further information on Solazol colours, given by Mr. J. S. Wilson, of Scottish Dyes, Ltd., in a recent paper read before the Manchester Section of the Society of Dyers and Colourists. It appears that the only member of the series at present on the market is Solazol Red 2B, although a yellower brand, Solazol Red 2G, is expected to be ready for sale within a week or two, and an orange and a yellow of the same series are promised for the near future.

These Solazol colours are made by coupling a diazotised amino anthraquinone, which has been solubilised by esterification, with a body of the Naphthol AS series. In its mode of application it resembles the Indigosols and Soledon colours, being applied to textile fabrics by normal dyeing or printing operations, and fixed by a short treatment in an acid oxidising bath. A new range of Azoic colours, made by the I.-G., is also now becoming available. These are the Rapidogenes, which are mixtures of naphthols with appropriate diazotised colour bases stabilised by a new method. The method of application is similar to that of the well-known rapid fast colours—printing, and fixation in a hot acid bath. There is a full range of shades, from bright yellow, through orange, scarlet and red, to deep blues, all of excellent fastness. One of the great advantages claimed for these colours over the rapid fasts is their much greater stability in solution.

Scotland

The reports of the large volume of new orders obtained at the cotton section of the British Industries Fair provided a bright spot during the month and it is to be hoped that these may be regarded in some measure as a good augury.

The three representatives of the Scottish woollen industry left for America on Wednesday of last week, with high hopes for their visit. It has been suggested that a separate deputation should be sent to France, whose activities will synchronise with those of the American delegates. Paris is still believed to dictate fashions to America's best dressed women, and the use of Scottish fabrics in new creations would be a powerful argument in favour of the American delegates.

argument in favour of the American delegates.

Mr. Deachmann, representing the Canadian Council of Agriculture, has protested to the Tariff Sub-committee of the Canadian cabinet against the increased woollen duties, saying that, as a result, the cheaper grades of clothing have been increased by 96 per cent.

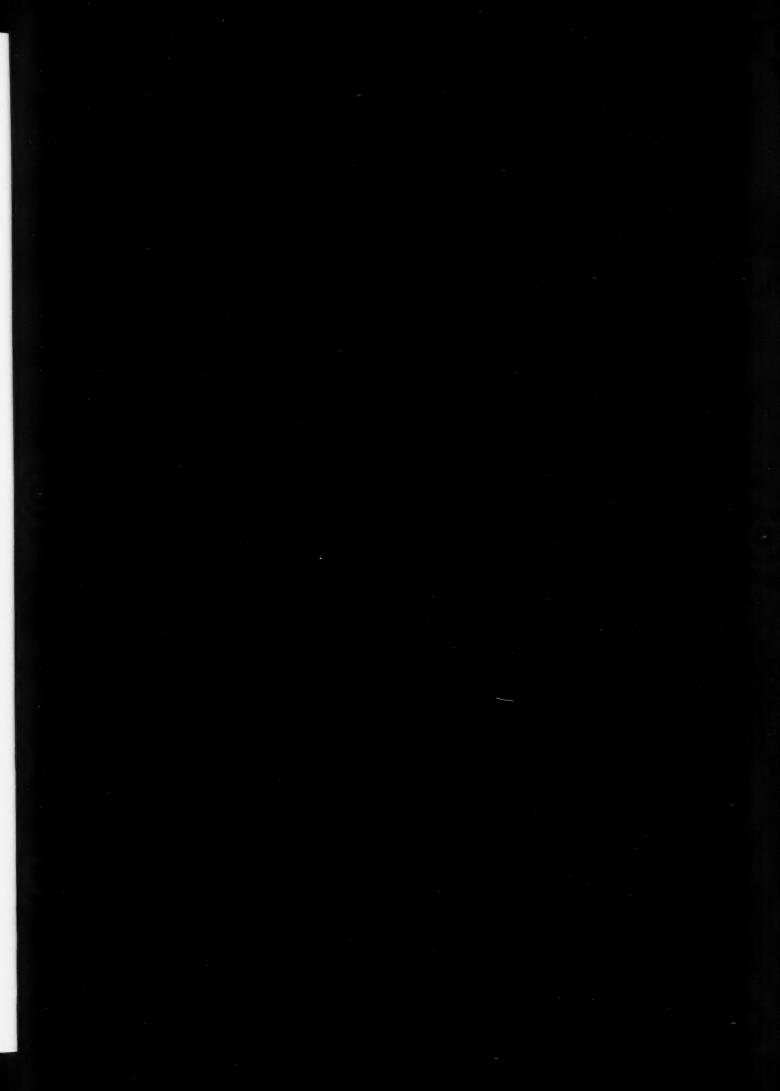
Coming now to company reports, J. and P. Coats have paid their usual quarterly dividend of 9d. per share. Fleming, Reid and Co., Greenock, have repeated their usual dividends, including 15 per cent. on the ordinary shares, although the year's profits have been less. In the report of the Linen Thread Co., the chairman referred to the political disturbances in India, increased tariffs in Australia, and changes of government in South American countries, as some of the factors which have made the last year difficult.

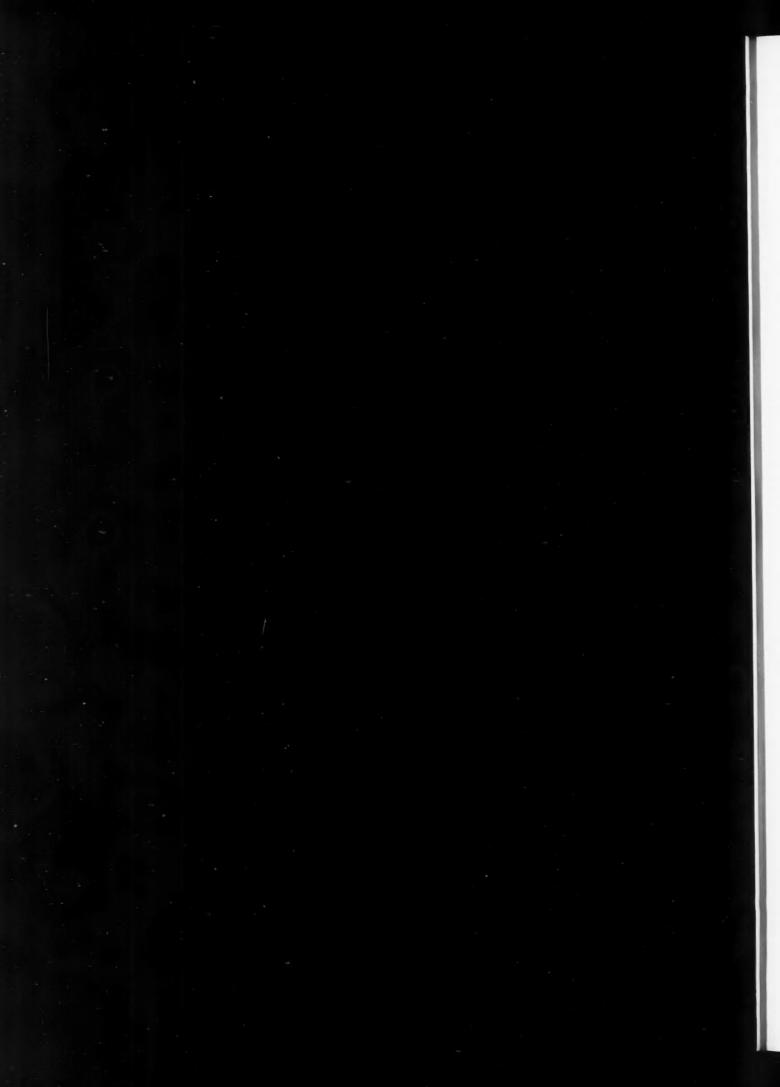
Hawick tweed manufacturers report a slight improvement in conditions, as a result of additional confirmation orders for next spring. Paton and Baldwins have reduced the price of their knitting yarns.

Business in chemicals and dyestuffs has remained quiet.

A History of Colour Making

DR. A. P. LAURIE, in a lecture given in London, described how the secrets of the making of colour centuries ago by the painters of Persia lie revealed today by modern scientific and chemical research. "You could almost write a history by studying paints," he said, "for you can trace important historical events by the particular paints used at different periods by artists in a particular country. We find on the whole that whether we take the illuminators in the West or the East, they always used mineral colours. From the earliest times minerals were used for painting in Europe, Persia, and China." A number of lantern slides used to illustrate the lecture were specially prepared in Edinburgh.





Dyestuffs Monthly Supplement

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British Alizarine Merger

Some interesting developments have taken place during the past month, prominent among these being the announcement with reference to the British Alizarine Co. It now appears certain that the offer of Imperial Chemical Industries will be accepted, and with the inclusion of this company, with their experience of the manufacture of alizarines, the position of Imperial Chemical Industries with regard to the manufacture of fast colours should be stronger than ever.

A particularly interesting development in the Naphthol range has just been made by Imperial Chemical Industries, this being a green. Considering the great importance which the foreign manufacturers have attached to these Naphthols during the years since the war and the dozens of patents which have been taken out, it is very pleasant to see the first green coming from this country. In addition to its novelty, it is understood to have excellent fastness properties. This is not the first time Great Britain has scored in the way of filling gaps with greens.

In times of difficult trade it is always interesting to see exact figures, and the statement of the diminution of their dyestuffs sales by only 13 per cent. during 1930 by Imperial Chemical Industries is a reassuring one, indicating that the falling off in consumption of dyestuffs is not a very large one.

In Scotland business has been a little better during the past month and the outlook is considered more hopeful in the tweed trade, and orders are being placed more freely.

New I.C.I. Colours

The output of new colours from the works of Imperial Chemical Industries maintains a steady flow, and includes some very beautiful tones. Five new ones are just announced, namely, Caledon Gold Orange 3GS Paste and Caledon Red X5BS Paste, Durindone Pink FVS Paste, Duranol Red X3BS Paste and Chlorazol Black FBWS.

Caledon Gold Orange 3GS Paste, an addition to the well-known Caledon range, is shown in beautifully pure and brilliant tones on cotton yarn, viscose yarn, silk yarn, print and cotton piece. It is described as giving clear yellow orange shades of excellent fastness, and is suitable for the dyeing of all classes of cotton goods either in the open beck or in machines. It is especially valuable for the dyeing of viscose by virtue of its excellent level dyeing properties, and is of value to the dyer of natural silk because of its excellent affinity for this fibre. Caledon Gold Orange 3GS is applied in the usual manner, using the potash-formosul method. Ground shades produced with this product are suitable for discharging by the formosul-metabol process.

Caledon Red X5BS Paste, a milder and more subdued tone, is suitable for dyeing all classes of cotton goods either in the open beck or in dyeing machines, and is of special interest to dyers of this fibre, and to dyers of viscose, linen and silk, on account of its excellent fastness properties. Special care should be taken in vatting, as the full value is obtained only when vatting is carried out in concentrated volume for 15 to 20 minutes. It is applied in the usual manner using the potash-formosul method.

Durindone and Duranol Dyes

Durindone Pink FBS Paste, a delicate warm tone and an addition to the range of Durindone colours, gives shades

of great brilliancy and excellent fastness properties, and is suitable for application to all types of cotton material, particularly for coloured goods which are to be bleached in the piece. Calico printers will find it to be of great utility both for direct printing and for discharge effects, using formosul-method process. It is of special interest for the dyeing of viscose on account of its valuable property of giving even shades on material of irregular quality, and is commended to dyers of loose wool and slubbing by reason of its excellent fastness to milling and to silk dyers on account of its resistance to degumming, coupled with good fastness to light on the animal fibres. The colour is suitable for application to linen, giving shades of good penetration.

Duranol Red X3BS Paste, an addition to the Duranol colours, has a very glossy effect on acetate silk yarn, and looks particularly well on acetate silk piece and cotton-acetate mixed fabric. It is commended for the dyeing of all types of cellulose-acetate silk and mixed goods containing cellulose-acetate silk. It possesses excellent fastness to hot pressing and marking off; properties which make it of particular interest both to dyers and printers. On account of its excellent affinity and the level dyeing property always associated with dyestuffs of the Duranol range, it is suitable for the production of all shades from pinks to full reds. It is applied by the method usual for printing Duranol colours with the addition, if necessary, of soluble oil and glycerine.

New Chlorazol Black

The latest addition to the Chlorazol range is Chlorazol Black FBWS, a very true dead black. It is suitable for dveing all types of cotton materials, and is of interest for all purposes where direct cotton blacks of good shade and levelling power, good fastness to water, hot pressing, acids and alkalies come into consideration. This colour is specially valuable on account of its eminent suitability for dyeing the cotton in union materials, i.e., "burl dyeing," and the piece may be subsequently acid cross dyed with little change in the shade of the cotton. It possesses very good affinity at low temperatures and may be applied in milling liquors. Unlike other burl-dveing blacks there is little loss in depth of shade on the cotton when the pieces are subsequently washed off. Chlorazol Black FBWS is also very suitable for dyeing viscose artificial silk, jute, straw, tagal, wood chip and paper. It is suitable as a ground shade for the production of white or coloured discharge effects.

Dyestuff Licences

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during March, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 561, of which 439 were from merchants or importers. These were dealt with as follows:—Granted, 525 (of which 524 were dealt with within seven days of receipt); referred to British makers of similar products, 31 (of which 27 were dealt with within seven days of receipt); outstanding on March 31, 5. Of the total of 561 applications received, 551, or 98 per cent., were dealt with within seven days of receipt.

The Treatment of Water for Bleaching and Dyeing

By C. D. Blackwelder

There are many matters connected with the use of dyestuffs which do not receive their due share of publicity. A particular case in point is the quality of water which is used in bleaching and dyeing processes. The following paper was presented at a recent meeting of the American Society of Mechanical Engineers (Textile Section).

THE quality of water used for washing, scouring, bleaching and dyeing is a matter of great importance. The use of unsuitable water in such operations results in faulty work. Of all the raw materials entering into the above processes water is by far the most important, since it enters every stage of the operation, either as a vehicle for the chemicals used or as a solvent for the impurities which have been removed. The difference between the results obtained at two different bleacheries is very often due to the difference in the composition

For many years the importance of the character of water supply has been recognised. This consideration has largely controlled the original geographic distribution of the textile industry in the United States, the textile centres being located in the Eastern and Southern states where the water supplies are abundant and respond to purification treatment very readily. In recent years, however, much progress has been made in the field of water purification for textile plants, with the result of improvement in water supplies and textile products, and due to improved processes and equipment the textile industry is not now so dependent on geographic

Troubles due to Unsuitable Water

All raw water supplies require some form of chemical treatment with subsequent sedimentation, filtration, and in some cases softening. The average filter plant produces water that is practically free from turbidity and suspended matter and the water is fairly clear and sparkling. Due to the physical appearance of this water it is rarely suspected of causing trouble in the processing of the goods. Frequently goods are damaged to a greater or less extent due to certain minerals and colloids being left in the water, which are not visible to the unaided eye. Sometimes the raw water supply is polluted with sewage, bleachery and dye waste and other trade wastes and although the water is clarified, certain harmful elements have been left in the water. Certain spore forming bacteria also may be present in the water, which are hard to destroy and often give trouble in the bleachery by producing stains, peculiar odours and moulds

A very small amount of suspended matter will cause trouble in a bleachery when the water is allowed to circulate on the cloth or yarn. It will cause a precipitate which usually results in a brownish stain. The process of bleaching and dyeing yarn, in package form, is very sensitive to any suspensions and insolvent products formed by the chemicals used; therefore, water of the best quality is required. Often the bleacher or dyer is blamed for faulty work which is entirely

due to the water and is beyond his control.

Iron in its various forms is one of the greatest sources of trouble in water supplies. In a great many cases dyers blame their dyestuffs and chemicals for causing uneven dyeing when really the trouble is in the quality of the water. Sometimes the boil is perfect but due to circulating the water in the kier after the boil, suspended and colloidal matter is precipitated on the cloth. Very often these water stains are confused with "kier stains," which are often due to the precipitated pectin matter from the spent kier liquor.

Effect of Excessive Hardness

Water with excess hardness should not be used for bleaching and dyeing. Hard water is not so good a solvent as soft water. It causes secondary reactions with the chemicals used in the various solutions, with the result that more chemicals are required in the processing of a given quantity of goods.

Unsatisfactory results from the use of hard water are seen more often in the kier boiling than elsewhere in the bleach house. The calcium and magnesium salts, constituting hardness, form insoluble compounds with the alkalis and soaps

used in boiling, and these insoluble particles, if left on the fibre, become worked into the cloth and form a protective coating in spots which will not allow the goods to bleach properly. When the goods are dyed, these spots will then resist the penetration of the dye, causing light spots to appear in the dyed goods.

Textile plants should have well-designed and efficientlyoperated filter plants. Each year, more plant executives are realising that the quality of water they are using is not the best. In order to get a better product at a reduction in expense, they are modernising their old water treatment plant

or building an entirely new one.

Many water treatment plants in use today are being called on to produce satisfactory water for textile processing, but difficulty is being experienced in getting the quality of water required. Very few of the plants which are not functioning properly were designed especially to treat the raw water required. being handled. The proper chemical and physical studies of the raw water should have been made and the results interpreted correctly and applied in the designing of the plant. In some cases the production of delicate shades is impossible

Many of these water treatment plants have been designed without sufficient mixing chambers, in which the raw water and coagulant should receive proper agitation before passing through the stilling wall into the coagulating basin. In nearly every case the retention period in the coagulating basin is too short and the velocity through the basin is too great. In a number of cases the rate of filtration through the filter beds is also too high, and the sand in the filter beds is not of suitable quality and size for the particular water which is being filtered.

Control of Hydrogen Ion Concentration

On checking up the operating cost for such plants it has been found that chemical treatment is noticeably expensive. Due to improperly-designed coagulating basins and filter beds, the filter runs are short, resulting in the use of a high percentage of the filtered water for backwashing, and thus reducing the net output of the filter plant. Many such plants, too, are not provided with proper equipment for controlling the alkalinity and hydrogen ion concentration (pH value) of the filtered water. This is an important matter and should receive proper thought by all owners of filter plants.
water "running from hot water cooks when the running from hot water cocks when they are first turned on contains iron, which is due to corrosion in the pipe lines and heaters, and is caused by the presence of dissolved oxygen and carbon dioxide in the water. By controlling the hydrogen ion concentration of the water, this corrosion can be greatly retarded. Water lines supplying bleach and dye plants are very often badly corroded from the same

Particles of rust which enter bleach liquors and dye liquors will always cause trouble, but this trouble can be practically eliminated by proper treatment of the filtered water before

it leaves the water treatment plant.

Many of the so-called troubles in the bleachery and dye house can be avoided by proper treatment of the water supply. Proper study should be made of the particular water which is to be treated before designing the water treatment plant. Full knowledge of the processes and the chemical reactions involved in the bleachery and dye house should be known before deciding on the chemical treatment of the water. Tests should be made on the raw water over a period of several months if possible, and these tests should include complete mineral analyses, as well as bacteriological studies. Observations should also be made on the chemical dosage required, size of the "floc" formed by the coagulant, rate of floc formation and precipitation, nature of the colloids, turbidity and colour removal. The corrosive properties of the water, with a view to eliminating this evil, is another point which should receive attention.

Basic Intermediates for Dyestuffs: No. XLII.—Brominated Compounds as Dyestuffs Intermediates—(continued)

By "Consultant"

In the previous contribution to this series a number of compounds was discussed in which the modifying influence of the bromine atom on the colour of the indigo molecule was made use of to obtain various shades. As a matter of passing interest its mentioned that the complete synthesis of an octobromoindigo (17) has been accomplished by Grandmougin, starting from tetrabromphthalic acid. Other possibilities which have been explored comprise the synthesis of nnsymmetrically halogen substituted indigos. The principal of these is 5:7-dibromindigo which can be obtained from 5:7-dibromistin (18). This intermediate may be obtained in very minute crystals by warming isatin with the exact molecular proportion

of bromine in concentrated sulphuric acid solution. When the bromination has been completed the mixture is poured into water, when the dibromisatin separates and may be filtered off. It has a melting point at 249° C. When this dibromisatin is condensed with indoxyl, a procedure which might be expected to give rise to the dibrominated indigo (19), the corresponding derivative of indirubin is obtained. To obtain the 5:7-dibromindigo, the dibromisatin is converted to the acid chloride and condensed with indoxyl, when the required substance is obtained.

As might be expected the brominated indirubins are possessed of considerable tinctorial properties. They are readily obtained, as in the case already discussed, by the condensation of the required bromine substituted isatin with indoxyl. Friedländer prepared the 6: 6¹-dibromoindirubin (20) as a reddish dye similar in many respects to the 6: 6¹-dibromindigo from the *Murex brandaris*, but which dyes cotton cherry-red from a hydrosulphite vat. The preparation of the

unsymmetrical dibromoindirubins (21) has been protected by Patent (G.P. 203,437), but there is no record of their commercial use, in spite of the fact that they dye wool a deep red colour.

As a class, the thioindigos have yielded more successful halogenated dyestuffs than almost any other group. The Thioindigo Reds (or Helindone Reds) which have been much used are, of course, the chlorine derivatives of the thioindigo nucleus, but the bromine compounds are products of almost

equal importance. Thus, $5:5^{1}$ -dibromothioindigo has been used as Ciba Bordeaux B, and an even wider success has attended the use of the $4:4^{1}$ -dimethyl- $6:6^{1}$ -dibromothioindigo, usually known as Helindone Pink BN (22). Further-

more it has been possible to obtain, by the condensation of the chloride of dibrominated isatin with thioindoxyl, compounds of the semithioindigo class, of which (23) is an example. They are, therefore, derivatives of Ciba Violet A, or 2-indol-2-thionaphtheneindigo (or semithioindigo). Bromine has also been used for the final stage in the preparation of thioindigo itself. When thioindoxyl is treated with bromine it yields a dibromo compound, and this, in turn, when heated in a suitable solvent at 150° C. loses bromine and forms thioindigo in quantitative yield. This dibromide (24) is also capable of giving thionaphthenequinone (25) by hydrolysis with lead acetate solution, a fact which makes the preparation of

thionaphthenequinone an easy method of obtaining dyes of the semi-thioindigo class, since it will combine with indoxyl or oxindole. An excellent example of a well-known dye of this class is Ciba Red G (26), which is obtained by the condensation of 5:7-dibromisatin with hydroxythionaphthene,

while an interesting blue vat dye can be obtained by the condensation of dibromisatin with α -hydroxyanthrone. It need scarcely be added that dyes of interesting properties can be obtained by using acenaphthenequinone, or acenaphthone in the condensations above. The relative cost of these acenaphthene intermediates makes the preparation of such dyes an uneconomic proposition.

Fused Rings from Bromine Compounds

Reference has already been made in previous articles to the use of brominated derivatives of the anthraquinone series for the preparation of compounds of the fused ring type. Two additional types of reaction are discussed below. In the first place, the complex rings of the carbazole family can be obtained with extreme ease by the use of 2-bromoanthraquinone (28). This compound may either be converted into 2:21-dienthraquinonyl (for practical details see a previous article in this series) and thence to I:2:11:21-dianthraquinone-

carbazole (30), or preferably it may be dinitrated, converted into the corresponding diamino-dianthraquinonyl (29). This

latter compound loses ammonia on baking with zinc chloride and yields the required dianthraquinonecarbazole. It forms a red vat which dyes cotton a fast bright yellow. Yet another example of the use of bromine in this particular type of ring formation is the condensation of 1-p-tolylamino-4-m-brombenzoylaminoanthraquinone internally with the loss of ammonia to give 4-m-brombenzoylamino-4-methyl-1: 2-anthraquinonecarbazole. Such compounds yield fast dyes but are too expensive in preparation for general use.

A very similar method may be used for the preparation of certain of the indanthrenes. When indanthrene is heated with bromine the bromination does not proceed normally, but a dibromoanthraquinoneazine (31) is formed. This, on boiling with quinoline yields 3: 4: 4 tribromoindanthrene (32), a dye which is almost completely fast to chlorine. The synthesis of

of heat and copper powder on the amino dibromoanthraquinones, and a whole series of such compounds has been prepared on an experimental scale.

Finally, it may be mentioned that a whole series of patents have been granted which cover the preparation of all types of fused rings through the medium of the bromine derivatives. Considerable care must be used in sorting these out into two groups, one in which the presence of the bromine is an essential feature, and another in which the word "bromine" is used as suitable verbal padding, being thrown in with "chlorine" and "iodine" to enlarge the scope of the patent.

I.G. Acquisition in Italy

THE Frankfurter Zeitung reports that negotiations for the financial reorganisation of the Acna concern, the large company in Italy's dye industry, have been completed. Besides manufacturing dyes, the Acna concern makes general chemicals, pharmaceutical products and explosives. The Compania Italiana del Gas has agreed to take over the Acna's interests in pharmaceutical and explosives production. The sections of the Acna concern relating to the manufacture of dyes, intermediates and inorganic chemicals will now be acquired jointly by I.G. Farbenindustrie and the Montecatini Co., an Italian chemical concern.

Determination of the Action of Light upon Dyed Textiles

This subject has received the attention of Dr. Paul Krais in a recent issue of Kolloid-Zeitschrift. It is said that the measurement of hours of sunshine, which offers no difficulty with the customary meteorological instruments, is not sufficiently accurate where fading effects in textiles are to be observed; photochemical methods, proposed by various investigators since the time of Bunsen, are also more or less useless. A photographic method for measuring light action must, therefore be adopted, making use of a "fading-hour" scale built up from slips of paper coated with a preparation of the dye which is to be tested.

The author's first task in attacking this problem was to try out coatings of dye-lakes prepared from the noticeably fugitive coal tar dyestuffs. He found that precipitations of Victoria Blue B upon kaolin were the most promising, for the fading of this combination is so evident that, within the first hour of exposure to direct sunlight, a distinct difference can be noted between each quarter hour, and within the next three hours it can be noted between each half hour.

The procedure adopted in the preparation of the light sensitive standard is as follows: 200 g. of white kaolin are stirred up with 200 c.c. of water, and to the paste are added 400 c.c. of a solution of I g. of Victoria Blue B per litre: the whole is well stirred, filtered, dried in air in the dark, ground up, and sieved. The colouring matter, made ready for painting on by mixture with some suitable binder, such as white glue or gum arabic, is now coated upon good white paper (free from wood-pulp) and dried; when dry, this "blue-paper" is ready for use and must be dried and stored in the dark.

The fading-hour scale is now constructed in the following manner: 12 slips of paper are fastened upon a board, and this is placed in direct sunlight, the sunrays falling perpendicularly upon it, on a perfectly clear day, between 11 o'clock and 2 o'clock. During this time, successive slips of the paper are removed at the end of each quarter hour, till the first hour is gone; then, at intervals of every half hour. In this way standard "fading-hours" from 0 to 5 are measured off. In the exposure of dyeings, it is suggested to expose a slip of fresh paper with the samples, the paper being changed from day to day (in good weather), and in this way it is then possible to sum up the effects of periods of 10, 20, 50 or more fading hours.

This method of testing the measured action of light upon dyeings is independent of the weather, of the time of year, and of the angle of incidence of the sunlight; but it is dependent upon the place where the standards are established.

United States Imports of Dyes

IMPORTS of coal-tar dyes, excluding alizarins, into the United States during 1930 amounted to 4,952,000 lb., against 7,593,000 lb. in 1929. From the following table it will be seen that every country with the exception of Britain suffered from the reduction in business.

	(Lb.)	(Lb.)
Principal Suppliers :-		
Germany	4,685,000	3,103,000
Switzerland	2,563,000	1,557,000
France	108,000	44,000
Britain	92,000	114,000
Belgium	76,000	63,000
Total U.S. Imports	7,593,000	4,952,000

Dyeing Trade Wages

Representatives of the employers and the trade unions in the dyeing and finishing industry of Lancashire, Yorkshire Cheshire, and Derbyshire again met in Manchester, on April 8, to consider the employers' proposals for wages reductions. At the close of the proceedings, which lasted four hours, it was officially announced that a "basis of agreement" had been reached which "involves reductions in wages." The agreement is to be submitted to a conference of the full executive committees of the unions in Manchester to-day, when it should be accepted or rejected on behalf of the workers. The reductions now "agreed" upon have not yet been disclosed.

Dyes and Textiles

Notes on Current Researches

Cellulose Nitro-acetate Effect Threads.—The unique properties of cellulose acetate rayon has made this fibre useful in the weaving of cotton and wool fabrics which have subsequently to be dyed in two colours, either to show a two-coloured pattern or to contain coloured effect threads or selvedges. But it has been found a source of difficulty in certain cases that the cellulose acetate rayon yarns are affected by boiling processes such that they lose their lustre or become woolly in marked contrast to the cotton or wool fibres with which they are associated. According to E.P. 340,501, rayon made from a nitro-acetate of cellulose is much more stable than the acetate itself and it is proposed to use such rayon for effect threads in materials which must be capable of withstanding treatment with boiling aqueous liquors.

Nitro-acetate rayon has dyeing properties of its own and is able to resist various direct and acid dyes; it lends itself to the easy production of two-coloured effects in much the same manner as does cellulose acetate rayon. From other observations it might be anticipated that cellulose nitro-acetate rayon would have superior stability towards boiling liquors, since it is already known that the sulpho-acetates are particularly stable. It would seem that the stronger the acid combined with cellulose, the more difficult it is to remove the acid groups by hydrolysis methods.

Although the desired stability of the rayon is secured by use of a cellulose nitro-acetate containing as little as I per cent. of nitrogen, it is likely that this small content of nitro-cellulose will give the rayon considerably increased inflammability. Researches previously carried out by N. Evers have shown that if rayon be manufactured from mixtures of cellulose acetate and nitro-cellulose the acetate content exerts very little fire-proofing action. Hence in utilising this recent discovery regarding the stability to boiling of nitro-acetates of cellulose due regard must be paid to risks from inflammability.

Softening Textile Materials.—At the present time activity is being shown in the preparation of auxiliary agents for use in the textile industry. Thus Turkey red oil, once so widely used in dyeing and finishing, has to a large extent been replaced by similar products but distinguished by a much higher degree of sulphonation. In much the same manner it appears likely that common soap will soon be substituted by synthetic detergents having an alcoholic rather than a carboxylic character, and the recent introduction of Igepon A, which does not form an insoluble lime soap in hard water, is illustrative of the progress which is being made in this direction. But there is also a need for improved softening agents which can be applied to textile materials.

In the past, Turkey red oil has largely been employed for softening cotton and rayon yarns and fabrics, but it suffers from various defects. Thus it gives an unmistakable odour to the goods to which it is applied, and it also leads to the formation of oil spots if acidic conditions develop during its application. It is therefore of interest to notice the claim made in E.P. 339,858 that the true sulphonic acids prepared from carboxylic acids of aliphatic saturated hydrocarbons containing more than eight carbon atoms prove to be extremely useful for softening

purposes. Among the aliphatic acids capable of yielding useful true sulphonic acids may be noted stearic, palmitic, lauric, and myristic acids. When rayon yarns are impregnated with 0.05 per cent. aqueous solutions of these products and then dried they become extremely soft and agreeable to the touch. Also the treated rayon yarns lend themselves better to knitting and manufacturing purposes in which friction between the yarn and machine parts can result in damage

Delustring Cellulose Acetate Rayon.—A surprising number of processes have been patented recently in connection with the delustring of cellulose acetate rayon. E.P. 318,467 describes one of the most recent processes, in which a reduction of lustre is obtained by precipitation within the rayon filaments of comparatively small quantities of insoluble inorganic

salts, such as barium phosphate and sulphate.

As is well-known, cellulose acetate rayon does not easily absorb inorganic salts, so that it is more satisfactory if in the

delustring treatment the rayon is first subjected to the action of a swelling agent. In certain instances, the swelling agent may also be useful in the precipitation process. Thus a useful method consists of steeping the rayon for one hour at 70 C. in a 25° Tw. solution of barium sulphocyanide (most of the sulphocyanides swell cellulose acetate) and then treating with a cold 1 per cent. solution of sulphuric acid; barium sulphate is thereby precipitated within the rayon and reduces its lustre. In another method the rayon is swelled by steeping at 50° C. in a 20 per cent. solution of formic acid, then treated for a few minutes at 70° C. in a cold 1 per cent. solution of barium chloride, and afterwards treated with a 1 per cent. solution of phosphoric acid.

Cellulose acetate delustred by such inorganic substances is more permanent than when delustred by boiling in soap solutions, since its original high lustre is not restored by such processes as hot ironing.

Dyeing of Cotton-Rayon Materials.—The application of direct cotton dyes to woven and knitted goods composed of cotton and a cellulose rayon, such as viscose or cuprammonium, is attended with several difficulties mainly because of the different affinities of cotton and rayon for such dyes. Generally the rayon tends to dye to a deeper shade than the cotton and because of this the dyed materials have a bare or streaky appearance in distinct contrast to the solid appearance which is desirable. Useful information relating to this problem is to be found in a recent article by H. Hoz and E. Bauder.*

From the investigations of these workers it would appear that it is not true to state that a cellulose rayon has a greater affinity than cotton for direct dyes without reference to the conditions of dyeing, for it has been proved that in pale shades the cotton has the greater affinity; it is only after a certain minimum depth of the shade has been exceeded that the rayon reveals a greater affinity for direct dyes. The affinities of the cotton and rayon must thus become equal in a depth of shade which will vary from one dyestuff to another.

The affinity of a rayon for direct dyes can also be considerably modified by the addition of soaps or salts to the dyebath; this fact has been excellently brought out in the researches of Weltzien and Schulze. Having these facts in mind, Hoz and Bauder have established that one or other of the following methods of dyeing enable solid shades to be obtained with cotton-rayon goods; the most suitable of the methods can only be determined by actual trials with the goods to be dyed.

First Method (mostly suitable for stockings and fabrics of cotton and Bemberg rayon).—Enter the material into the dyebath at 80–90° C., which contains 2–3 grams of Monople soap per litre; raise to the boil and dye for $\frac{3}{4}$ to 1 hour.

Second Method (suitable for all cotton-rayon goods to be dyed in pale shades).—Enter the materials into the dyebath at 80-90°C., which contains 2 grams of Monople soap per litre; raise to the boil and dye for ½ to ¾ hour with the addition of 1-10% of Glauber's salt. It is necessary to add the maximum amount of salt when the depth of shade is least.

Third Method (suitable for dyeing in dark shades all cotton-rayon materials).—Enter the goods into the dyebath at 80-90° C, which contains 2 grams of Monople soap per litre, and also 5% of Glauber's salt; raise to the boil and dye for 15 to 20 minutes, then cool to 50-55° C., add a further 20-30% of Clauber's salt.

of Glauber's salt and dye for a further ½ hour.

Immunising Cotton.—A method fortreating cotton such that it has no affinity for direct dyes whilst it readily absorbs basic and cellulose acetate dyes has recently been protected.‡ The cotton is first treated with caustic soda of mercerising strength and preferably at about o°C., then pressed so as to retain about twice its own weight of the alkaline liquor, and afterwards exposed to allyl bromide vapour. Reaction occurs between the alkali-cellulose in the cotton whereby an allyl cellulose is formed, but because of the conditions employed no structural change occurs in the cotton. As a result of this conversion the cotton may gain up to 25% in weight.

* Melliands Textilberichte, 1931, 12, 189. † Die Seide, 1930, p. 451. ‡ E.P. 342689.

Dyes and Dyeing: Technical Progress in 1930.—(III) By L. J. Hooley

Brown sulphide dyes are obtained by heating halogenated dinaphthalenedioxides with sulphur. The products obtained may be afterwards alkylated, although after alkylation they are no longer vattable, so that the textile purposes the alkylation must be done on the fibre. The products obtained in this way are orange or bright red (B.P. 315,910, 317,776, 317,139, 325,519 (I.G.F.A-G.). Other bright colours reported during the year are the blue and green shades from leuco indophenols, obtained from p-aminophenol, and alkyl or aralkyl-\(\alpha\)-naphthylamine-6 (or 7) sulphonic acids (B.P. 330,308, I.G.F.A-G.). Brightly coloured dyes are also stated to be obtainable by the use of molybdenum compounds in sulphur melts, a range from red to violet being described.

Azo Development Colours

Some further constitutions have been elucidated by Professor F. M. Rowe, Naphthol As-E having been found to be the p-chloro anilide, AS-OL the o-anisidide and AS-BG the 2: 5-dimethoxyanilide of β -hydroxyanphthoic acid. Further, Fast Red RBS base is 6-benzamido-m-4-xylidine hydrochloride and Variamine Blue is as shown. An interesting and rather

$$C_2H_5$$
 $N : N : CI$

surprising result is the production of greens using naphthol bases concaining an amino-, arylamino, or aralkylamingroups in the 6-position (B.P. 330,349, 326,971, I.G.F.A.-G.) New violet to blue members can be obtained by making use of salts of monoaroylated p-phenylenediamines. A blue may also be obtained by coupling 2:3-hydroxynaphthoyl-paminodiphenylamine with dianisidine and coppering (B.P. 332,319, I.G.F.A.-G.). 2:4-Dihydroxyquinoline gives much better dyes after coupling; if it is substituted, thus 2:2¹:4:4:4¹-dihydroxy-6:6¹-diquinolyl with diazotised aminoanthraquinone gives a brown red (B.P. 332,940, I.G.F.A.-G.).

Level-dyeing Viscose Colours

The previous important developments of Imperial Chemical Industries have been amplified and extended in patents appearing during the year. One or two typical ones may be noticed. In B.P. 331,839 (I.C.I., R. Brightman and W. L. B. Wellacott) a 3: 3¹-diaminodiphenyl-carbamide, free from hydroxy, carboxyl and sulphonic groups is coupled on the one side with a phenol- or naphthol- carboxylic or -sulphonic acid and on the other with γ acid, an N-substituted γ -acid, or a 1: 8-dihydroxynaphthalene sulphonic acid. Diamines such as the one below

or similar ones having a chain of more than 2-methylene groups or methylene and carbonyl groups are coupled with suitable components, chosen so that the resulting dyes have at least 2 acid groups to confer the necessary solubility. (B.P. 332,954 I.C.I., R. Brightman).

Direct Dyes

The direct dyes other than the class of the preceding section differ too much to be briefly described. Very pure polyazo greens are obtained by diazotising an aromatic amine and coupling through a suitable α -naphthylamine middle component with a cyanuric compound. X: Cy (A.R.) where A is a 1: 8-aminonaphthol, R an aminazo residue and X halogen or an amino-thiol or ether residue. A number of amino-benzoylaminonaphthols of constitution such as

are a feature of some of the patents. Diazotised aminoazines containing the grouping

where R is an aryl residue can be used for direct colours. Interesting azo compounds are those obtained from enolic sulphuric esters containing also azo linkages, as, for example, by treating aminoanthra hydroquinone-9: 10-disulphuric esters under conditions so that diazotisation takes place instead of oxidation, and then coupling.

Diazo preparations, diazotisation, etc., were dealt with in the December issue of the Dyestuffs Supplement.

Chrome and Acid Dyes

Some very bright chrome greens have been claimed during the year by coupling 2: 3-aminonaphthoic acid with a diazotised o-aminophenol sulphonic acid. Monazo dyes as deep as blue-green in shade can be obtained by coupling acylated r: 8-aminonaphthol sulphonic acids with certain acylamino-alkoxy-o-toluidines (B.P. 307,303, I.G.F.A.-G.), the products being suitable for wool. Two or three patents deal with acid colours containing pyrazolone nuclei, the colours being generally yellow; thus dichloroaniline is diazotised and coupled with a halogenated sulphoarylmethylpyrazolone such as I-(2-chloro-5-sulphophenyl)-3-methyl-5-pyrazolone (B.P., 301,096, S.C.I.B.). A chrome orange-yellow equal to Phosphine in brightness is obtained by sulphonating, reducing and diazotising o-chloro-p-nitrotoluene and coupling with resorcinol (I.G.F.A.-G., B.P., 313,027).

(I.G.F.A.-G., B.P. 313,927).

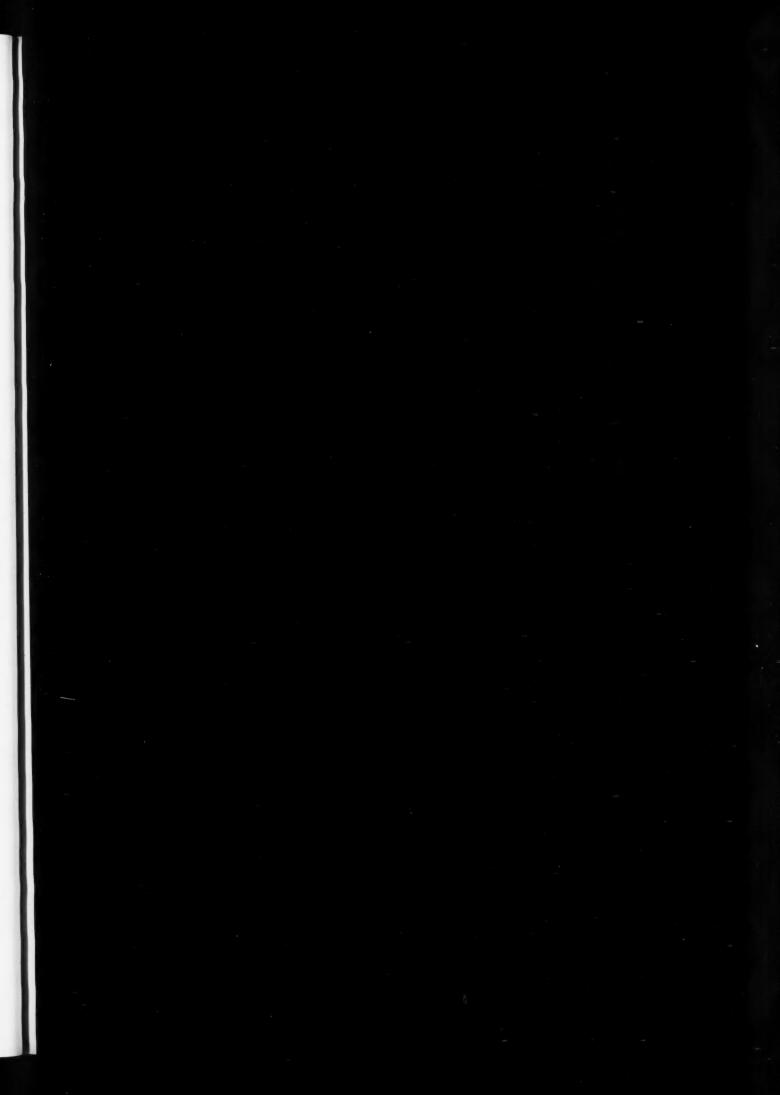
Among the dyes which already incorporate metal, the main lines have already been exploited and recent developments deal mainly with variations in precedure, such as the addition of assistants to the medium which in the synthesis is carried out, among the assistants being the now almost ubiquitous wetting agents.

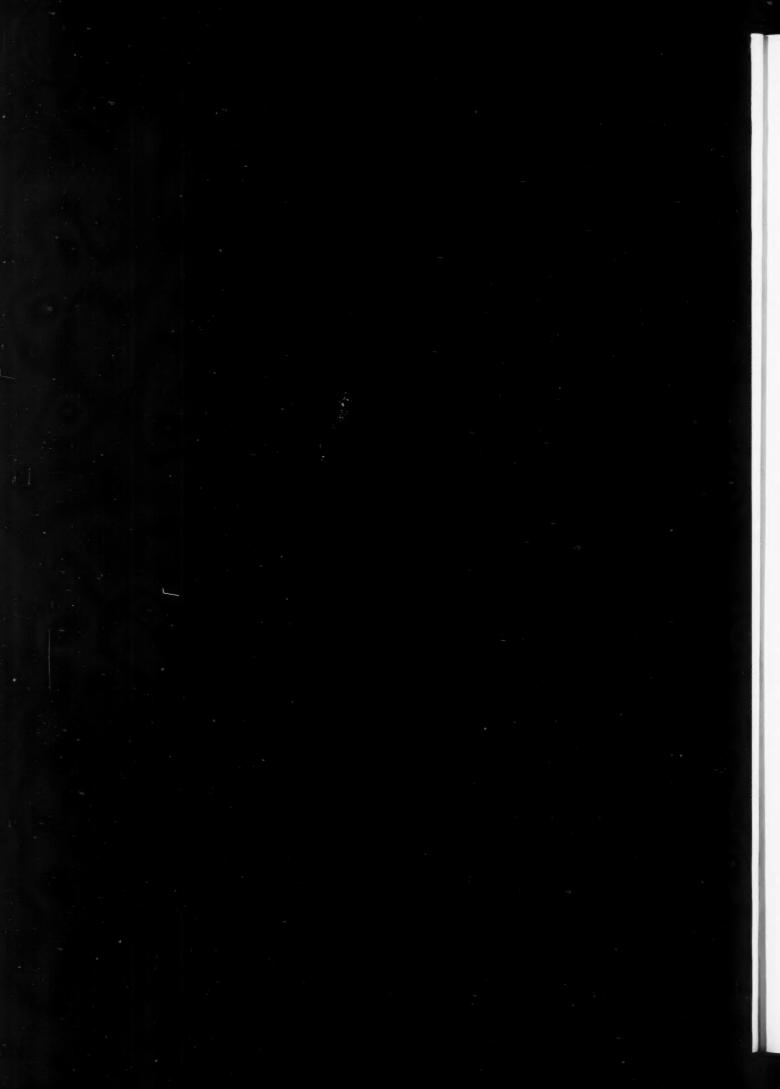
The Mechanism of Dyeing

AT a lecture delivered before the Dye and Textile Chemistry section of the German Chemical Association, on the occasion of their recent annual meeting at Frankfurt, Professor E. Elod referred to work which had been carried out upon the absorption of acid dyestuffs by wool. He said that the part played by the acid-dyes cannot exactly be compared with that of the weak, colourless acids used as "additions." Before the dye-acids are taken up, the formation of protein salts is a primary necessity. Only then can the Donnan ion-grouping, taking place in such systems, force the taking up of dyestuff acid anions. Direct experimental proof of this view has not yet been possible, but nevertheless it has been possible to prove that, after the partial saturation of the basic groups of the wool-substance by dyeing with an acid dyestuff, and subsequent electrodialytic purification of the partly-dyed wool, the power of taking up acids, possessed by such wools, becomes distinctly and proportionally less, according to how much more dyestuff acid had been taken up in the pre-treatment. Other factors also play some part in dyeing. For instance, the presence of neutral salts diminishes the absorption of the dyestuff.

American Spring Colours

THE U.S.A. Textile Colour Card Association has just issued its Colour Correlation Chart for spring and summer, 1931. In the chart the fashionable colour families for daytime and evening wear are listed accordingly, and for each group are given the co-ordinate colours for accessories, including shoes, bags and hosiery. The new blues for street wear, for example, are classified as navies, flag blue types, and greyed blues. As colour combinations will constitute an outstanding fashion for spring and summer, special significance is attached to that portion of the chart which suggests the smartest colour harmonies and contrasts.





Dyestuffs Monthly Supplement

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Dyestuffs Production Figures

WE publish in this issue the figures for the year 1930 of British dyestuffs production, together with those for 1929. A comparison shows an all-round reduction between the two years, the 1929 total of 55.785.032 lb. having fallen to 42.590,243 in 1930. The matter is referred to in our ordinary editorial columns.

Autumn Shades

Already included in the matter issued by Imperial Chemical Industries is a list of fashionable shades for next autumn. They are submitted as suggestions only, and recipes for the production of any other desired shades or any type of material will be supplied on application. A characteristic of the list is the quietness of the selected tones as shown on heavy cloth. The twelve shades are named Spray, Magnolia, Midnight, Marine, Cedar, Garnet, Mignonette, Peat, Lapin, Pewter, Myrtle, Negro and Graphite.

The New Fast Green

Some particulars have already been published about Duranol Green BS Paste, the new fast green produced by Imperial Chemical Industries. Shown on the pattern card, one is at once struck by its brilliance and delicacy when applied on acetate silk piece, acetate silk yarn, and cotton-acetate silk mixed fabric. Duranol Green BS is the first homogeneous direct dyeing fast green of the acetate silk class and is applicable to all classes of cellulose-acetate goods and to mixed goods containing cellulose acetate silk. It is dyed at a temperature of 165-185° F. (75-85° C.) in the manner usual for Duranol colours. When used in conjunction with dyestuffs of other classes, as when dyeing mixed materials containing cellulose-acetate, assistants such as acetic acid, soluble oil, soap or salt may be added to the dyebath if necessary. Duranol Green BS is applied by the method usual for Duranol colours with the addition, if necessary, of soluble oil and glycerine.

Two More New Colours

Two further new colours are announced by Imperial Chemical Industries, namely, Caledon Grey 3R Paste and Chlorazol Catechine BS. The former has a very delicate and satisfying effect as applied to cotton in both yarn and piece and takes on an added brilliance when used on viscose yarn. Caledon Grey 3R is suitable for the dyeing of all classes of cotton materials either in machines or in the open beck and is also suitable for use on viscose, linen and silk. It is dyed according to the details set out under Group r in the pattern card "Caledon Colours on Cotton." Its dyeing and fastness properties vary from very good to excellent.

Chlorazol Catechine BS is a direct dyeing dyestuff giving deep chocolate brown shades. It is specially suitable for use in piece dyeing, one particular feature being its excellent dyeing properties, which enable large batches to be dyed without danger of "ending" or similar troubles. It possesses very good fastness to water, acids, perspiration, hot pressing, and rubbing, all of which are points of special interest to piece dyers. In addition it is very suitable for

dyeing chain warps, as the requirements of the two trades are very closely related with regard to dyeing properties. It is also of interest for yarn dyeing where deep chocolate shades of good fastness come into consideration. It is snitable for dyeing silk, viscose, paper, jute, tagal and wood chip, and is also of interest for the production of brown shades on full chrome leathers.

This colour is of interest to printers as a ground shade for the production of white or coloured discharge effects on cotton, viscose and silk. Chlorazol Catechine BS possesses good affinity for the cotton fibre and is slow and regular in speed of dyeing. The colour "builds up" well in heavy shades; the maximum affinity being obtained just below the boil with normal additions of salt. The colour tends to level up by "boiling off" the fibre at high temperatures, particularly when small amounts of salt are used.

Colours on Linen Yarn

A pattern card of more than usual interest, issued by Imperial Chemical Industries, contains samples of 32 Caledon and six Durindone colours suitable for application on linen yarn. The Caledon and Durindone Colours, which belong to the Anthraquinone and Indigoid Vat series respectively, are of unsurpassed fastness, and for the highest classes of fast coloured goods their use is essential, while, owing to the modern demand for faster colours, they are finding increasing use on goods of medium quality. This pattern card illustrates a selection of the Caledon and Durindone ranges which has been chosen after successful application in practice.

Methods of Dyeing

For Caledon colours, dyeing is conducted in the caustic soda-hydrosulphite vat and in their method of application the Caledon colours fall into three groups. The group to which any particular colour belongs is indicated in a table. In general it is advisable to use products belonging to the same group when producing compound shades, but there are exceptions to this rule. The dyeing operation is best carried out in wooden or iron vessels but no other metal should be used except Monel metal or stainless steel. The quantities of caustic soda, etc., required varies according to whether the goods are to be dyed in the beck or in The dyestuff is dissolved in a "stock-vat" machines. using half of the indicated quantities of caustic soda and hydrosulphite; 10-15 minutes are allowed for vatting to take place and the solution is then added to the dyebath containing the remainder of the caustic soda and hydrosulphite, and the Glauber's salt if required. The addition of 2 lb. of Perminal per 100 gallons of dye liquor is beneficial in securing more thorough penetration of the fibre. Dyeing is complete in three-quarters to one hour, after which the yarn is squeezed or hydroextracted, air oxidised, rinsed and scoured, and finally rinsed and soaped for half-hour at the boil.

The Durindone colours are applied in a manner similar to the Caledon colours. Owing to their superior solubility and the stability of their leuco compounds, the penetration obtained is superior to that obtained with dyestuffs of the Anthraquinone class.

Synthetic Wood Stains

The great extension in the use of synthetic colours is well illustrated in the collection of wood stains just issued by Imperial Chemical Industries. The wood dyer has here a choice of no fewer than 42 distinct shades, sufficient to meet practically every taste and need. They are divided into two groups—products soluble in methylated spirit and products soluble in water. A warning is given that certain products, duly specified, although belonging to the spirit soluble group, are also soluble in water, and may be applied to the wood from an aqueous solution. These products should on no account be used in admixture with products belonging to the second group, or precipitation will occur and a "muddy" effect result. The stains may be applied by brush, spray or pad, as may be convenient. The instructions are printed in English, French, and German.

British Colour Fashions

The new issue of the "Monthly Record" of the Manchester Chamber of Commerce contains an announcement to the effect that the British Colour Council is issuing a shade card which will make it no longer necessary for those connected with the fashion and allied trades to wait for guidance from other countries before preparing goods for a

certain season, as colours will be issued in time for British firms to prepare confidently in advance of seasons. The correlation chart, it is added, will be used by retailers in recommending hats, dresses, hosiery, shoes and other goods to prospective customers.

Mercerisation and Fastness

Conclusions, drawn from experimental work to determine the influence mercerisation has upon the fastness to light of dyes, are reported by Professors P. Victoroff and G. Zitler in a recent issue of L'Industrie Textile et du Commerce de l'U.S.S.R. Steps were first taken to obtain samples of same quantity of dye. The colours selected for the tests were Benzopure Blue, Diamin Green C, Benzopurpurin 4B and indigo. Fabric samples prepared with these dyes were exposed to the sun over a period of three months, changes being observed after 8, 24 and 50 days in the case of the substantive colours, and after 20, 60 and 90 days in the case of the vat colours. The differences in fastness of substantive colours on mercerised satin were apparent after an exposure of 8 days. The standard sample of unmercerised satin, although dyed to the same depth, changed still more quickly, showing the decided advantage of mercerisation.

British Dyestuffs: Production Figures for 1930

THE Board of Trade has compiled the following statement showing the quantities of the various main classes of dyestuffs which were produced in the United Kingdom during the year 1930. The statement has been prepared from returns furnished by the principal British dyemakers:—

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PRODUCTION OF	SYNTHETIC	DYESTUFFS IN THE	UNITED KINGDOM, 1930.

Category.	Blacks. lb.	Blues.	Browns.	Greens.	Oranges.	Reds. lb.	Violets.	Yellows.	Total.
Direct cotton colours	2,372,831	1,448,755	615,274	161,818	323,454	846,390	132,876	814,893	6,716,291
Acid wool colours	1,405,951	1,319,241	234,221	270,736	683,782	1,364,138	282,561	888,900	6,449,530
Chrome and mordant colours (including ali-									
zarine)	1,609,251	339,735	881,912	50,155	406,361	3,245,650	28,893	316,908	6,878,865
Basic colours	21,708	441,573	180,393	281,916	115,326	486,974	447,293	392,364	2,367,547
Sulphur colours	3,836,105	387,486	722,988	71,258	25,102	99,261	-	89,754	5,231,954
Vat colours (including	3, 3-1-3	5 111	, ,,	, , ,	-3,	221		27731	31-3-1234
indigo)	128,576	7,559,707	168,250	504,888	123,220	227,974	230,193	125,455	9,068,263
Dvestuffs for lake-							0	5.155	
making	41,261	687	25	100,453	-	1,111,906		91,565	1,345,897
Cellulose acetate silk									
colours	95,542	398,207	3,986	438	176,147	216,500	70,046	72,517	1,033,383
Oil, spirit and wax						- 20			
colours	292,967	406,148	6,849	276	22,247	16,031	7,434	32,116	784,068
Unclassified colours	57,698	16,827	33.558		4,754	14,091	900	510	*2,714,445
			33.33		17731	-47-2-			-17-1113
Aggregate total	9,861,890	12,318,366	2,847,456	1,441,938	1,880,393	7,628,915	1,200,196	2,824,982	42,590,243
		* Includ				nished			
* Including quantities not separately distinguished.									

Corresponding Figures for 1929

For the purposes of	comparison	we give be	elow the co	rresponding	figures fo	r 1929 :-			
Category.	Blacks. lb.	Blues. lb.	Browns. lb.	Greens. lb.	Oranges. lb.	Reds.	Violets.	Yellows.	Total. lb.
Direct cotton colours	2,467,943	1,684,257	626,592	249,782	354,992	879,095	147,311	978,753	7,388,725
Acid wool colours Chrome and mordant colours (including ali-	1,417,243	1,366,020	173,357	440,632	725,005	1,752,169	579,531	971,373	7,425,330
zarine)	1,782,860	618,806	923,111	82,321	627,677	5,160,149	40,639	379,171	9,614,734
Basic colours	_	489,862	194,775	330,562	103,186	478,428	526,402	427,922	2,551,137
Sulphur colours Vat colours (including	5,008,413	504,838	1,020,186	101,285	26,625	113,102	_	89,794	6,864,243
indigo) Dyestuffs for lake-	157,297	12,977,825	144,759	440,474	136,650	307,597	306,981	212,118	14,683,701
making	627	_	673	136,652	1,851	1,566,548	-	156,517	1,862,868
miscellaneous colours	472,362	740,046	69,816	24,306	148,476	184,416	68,862	98,709	*5,394,294
Aggregate total	11,306,745	18,381,654	3,153,269	1,806,014	2,124,462	10,441,504	1,669,726	3,314,357	*55.785.032

* Including quantities not separately distinguished.

Some Peculiarities of Fading By William H. Cady

The following extracts are from a paper which was presented at a recent meeting of the Northern New England Section of the American Association of Textile Chemists and Colourists. It deals with certain peculiarities of dyestuffs, to which further investigation might profitably be devoted.

The behaviour of direct dyes on cotton when exposed to light is a good illustration of the effect of the fibre on the fastness. Direct dyes on cotton fade by reduction, rather than by oxidation. That has been established by Harrison (J. Soc. Dyers Colourists, July, 1912, p. 225) in spite of the fact that most dyes fade by oxidation, although it has been stated over and over again that you cannot make a dye fade unless you have both oxygen and moisture present. In the case of direct dyes on cotton, however, there seems to be an exception, for, as Harrison proved, certain direct dyes will fade on cotton in vacuo, when exposed to a strong light from a mercury lamp. If these same direct dyes are painted on glass and similarly exposed, they do not fade. The reason for this is that when these dyes are exposed on cotton, the light converts the cotton partially into oxycellulose, and the dye is correspondingly reduced, while on glass there is no such reducing action. Basic colours are just the opposite; they fade in air but not in course. fade in air but not in vacuo. In other words, they require oxygen to make them fade.

Effect of Source of Light

Another factor that affects fastness is the method of dyeing. Mordants have a marked effect on some dyes. Gebhard (Farb.-Ztg., November 1, 1914, p. 393) found that Malachite Green dyed on cotton on a Turkey-red oil mordant would fade in less than a week; but when it was dyed on tannin and antimony and topped with sodium metaphosphate and glucose, it would stand 10 or 12 weeks of sunlight without fading. The fastness of a dye is also affected by the nature of the finishing agents used, and since practically all cotton fabrics are treated with some kind of finishing compound after they are dyed, this factor ought not to be overlooked. Some of these finishing agents increase fading, particularly castor and coconut oils; olive and corn oils do so to a less degree. On the other hand, dextrine, glucose, and stearic acid have a tendency to retard fading.

Another important item is the source of light. Taking the sun alone, we get materially different fading whether we employ direct sunlight or north sky light. has already been found that to equal in north light the amount of fading produced by two days of direct sunlight required from 3 to 61 days, according to the dye exposed. There is also a material difference in the quality of the fading produced by direct sunlight and *cloudy sky* light, and a distinct difference between the fading produced only when the sun is shining and the fading which results from a continuous exposure, day and night, in all kinds of weather (suitably protected under glass), although the factor of humidity seems to have an additional

influence here.

Combination Fading

The presence of moisture and gases in the air also materially affects the fastness of dyes. Not only is moisture essential for fading, but some dyes are much more affected by moisture than are others. As regards gases, ammonia, alcohol and pyridine vapour, for example, increase fading; sulphur dioxide, on the other hand, is said to retard the fading of sulphur and azoic colours on cotton, but has an accelerating action in some other cases.

Some dyes fade rapidly at first and slow up later; others are just the opposite. In a poor light they may not show any perceptible change for a considerable time; then when the light is increased they start to fade quite rapidly. Alternatively, in exceptional cases, the dye becomes darker on exposure, as with a 50 per cent. dyeing of Patent Blue A, exposed for 48 hours in the fadeometer this dye turns much blacker, and

then on further exposure begins to go lighter.

Coming now to the subject of "combination fading," or the effect of one dye on another, it is well known that Indanthrene Blue GCD is an extremely fast dye, and that Anthra-flavone (or Anthra Yellow GC) is much less fast, yet when the two are combined in one dyeing, the yellow does not fade any more than the blue. This curious phenomenon has been commented on by Gebhard (Farb.-Ztg., November 15, 1914, p. 405), but no attempt has been made to explain it. In this particular instance the blue dye seems to retard the normal fading of the yellow, but more often the opposite is true. If Helindone Yellow 3GN is topped with a fast dye, Brilliant Fast Blue B, and with a fugitive dye, Dianil Pure Blue pH, the, resultant shades are about equally fugitive; here, therefore, the yellow has accelerated the fading of the fast blue so that it is no better than the fugitive one.

Accelerating Effect of Other Dyestuffs

Scholefield (J. Soc. Dyers Colourists, September, 1928, p. 268) found that when almost any vat yellow or orange was dyed on cotton and exposed to light while still in the leuco state, the cotton was badly tendered. He further observed that when a blue like Ciba Blue 2B was dyed in combination with one of these yellows, for example, Ciba Yellow G, and exposed to light in the leuco state, the blue was destroyed in a few minutes, but Indanthrene Yellow G is an exception to the rule, as this yellow neither tenders the fibre nor accelerates the fading of other dyes.

Indanthrene Yellow GN Extra (not to be confused with G) has the property of accelerating the fading of other dyes when exposed to light; and when it is dyed in combination with Indigo or Brilliant Indigo, the blue is completely destroyed on a short exposure. Dr. Hans Meyer attributes this to the fact that this yellow contains an atom of sulphur in its molecule. Another dye containing sulphur which acts similarly, is Diamine Fast Yellow FF. Scholefield (loc. cit.) states that if this colour is dyed on cotton and topped with Ciba Blue 2B and exposed to the fadeometer in the leuco state, the blue is destroyed in 10 minutes. It is interesting to note that in this case it is not a vat yellow which does the damage, but a direct yellow. This dye has a similar action on direct blues accelerating the fading of such colours as Benzo Fast Blue 4GL and Direct Fast Blue SFF.

According to L. A. Lantz, chief chemist of the Calico Printers' Association, England, if a combination of Alizanthrene Yellow GP and Indanthrene Brilliant Orange RK on cotton is exposed to light after ageing, while still in the reduced state, the orange fades but not the yellow. Chromazurine DN, Alliance Blue paste and Modern Violet DH are also all "reasonably fast to light" when alone, but when Chromazurine DN is mixed with either of the others, the resulting mixtures are

very much poorer.

It is well known that Indanthrene Yellow G, when dyed or printed on cotton and exposed to light, turns green, this being attributed to the reducing action of oxycellulose formed by the action of light on the cotton. On the other hand, when Indanthrene Yellow G is printed on acetate silk and exposed to light, no greening takes place. If, however, the acetate silk is first saponified by caustic soda, it then acts like cotton. Viscose, which should behave like cotton when similarly treated, actually seems to turn less green than either cotton or saponified acetate silk. Here, then, is something which requires further investigation.

Dyestuff Licences for April

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 511, of which 424 were from merchants or importers. To these should be added five cases outstanding on March 31, making a total for the month of 516. These were dealt with as making a total for the month of 516. These were dealt with as follows:—Granted, 478 (of which 467 were dealt with within seven days of receipt); referred to British makers of similar products, 32 (of which 29 were dealt with within seven days of receipt); outstanding on April 30, six. Of the total of 516 applications received, 496 or 96 per cent., were dealt with within seven days of receipt.

Basic Dyestuffs and Their Uses

Varied Effects Procurable by Dyer and Calico Printer

The portfolio of their Basic Colours just issued by Imperial Chemical Industries illustrates the wide range of shade available to the dyer and the variety of applications of which these colours are capable. The distinct colours, the depth of which can be varied with the strength of the dyebath, number 31, beginning with Acronol Yellow and ending with Malachite Green Crystals, the intervening shades running through the oranges, browns, violets and blues. These colours are shown on the sample cards applied not only to cotton yarn, but on silk, on wool, on viscose, on acetate silk, on leather, wood and paper, as used in lake-making, and applied to coarse material such as jute coir straw and raffa

material such as jute, coir, straw and raffia.

In some notes on these colours it is stated that the dyestuffs of the Basic group are amongst the oldest of the synthetic dyestuffs, and although the general fastness properties do not entirely meet modern requirements, considerable use is still found for them on account of their great brilliancy of shade. Their early appearance on the market and their extraordinary tinctorial power led to their adoption for the colouring of many miscellaneous materials, and these uses still persist to such an extent that the application on tannin mordanted cotton is to-day one of the lesser outlets for this type of dyestuff. On this account it is difficult to issue a catalogue of Basic dyestuffs which will aptly illustrate the colours and their many uses. Nevertheless, the producers have adopted dyeings on tannin mordanted cotton as a convenient method of illustrating their range of Basic dyestuffs and have indicated a few of the many uses for which Basic colours are found to be of service, together with the usual methods of use.

Application on Cotton Yarn

Mordanting.—Work the material in a short bath containing ½-5 per cent. tannic acid, calculated on the weight of the goods. The bath should be at 140–160° Fahr., and in the case of full shades the yarn is turned for about half-an-hour and then steeped overnight in the cooling bath. For medium shades two to three hours' intermittent turning in the cooling bath is sufficient, while for light shades about half-an-hour will suffice. In practice, for light and medium shades, the tannin bath is frequently used cold, but a warm or hot liquor is preferable, especially in the case of hard twisted or doubled yarns, as a more thorough and even penetration is thereby assured. When the mordanting is completed, the yarn, without rinsing, is wrung evenly or hydroextracted and worked for 15–30 minutes in a cold bath containing ½-2½ per cent. of tartar emetic. It is wrung, washed and dyed without drying.

Dyeing.—For full shades the dissolved dyestuff may be added to the cold dye bath (previously charged with I-2 per cent. acetic acid (30 per cent.) on the weight of the yarn) in one lot, the yarn entered and turned smartly until no further exhaustion of dyestuff from the liquor is evident. The dyebath is then heated gradually to 100–120° Fahr. and turning continued until the dye liquor is practically exhausted. It is to be noted that if the amount of mordant on the fibre is insufficient to fix the whole of the dyestuff employed the dyebath will remain more or less strongly coloured; on the other hand, an over-strong mordant causes the dyestuff to rush on to those portions of the yarn immediately surrounded by the dyeliquor and uneven dyeing results. In dyeing medium or light shades, it is preferable to add the dyestuff in two or three portions. This is advantageous also when dyeing full shades if levelling difficulties are encountered.

Application on Cotton Piece Goods

Mordanting.—The pieces are usually mordanted in the jigger or padding machine. The bath is prepared with i-4 per cent. of tannic acid, according to the depth of shade to be dyed and the pieces which are entered at 140° Fahr. are run in the cooling liquor for $1-1\frac{1}{2}$ hours. When the mordanting is completed the pieces are fixed in cold bath containing $\frac{1}{2}-2$ per cent. tartar emetic, two ends being given. After fixing the goods are well washed and dyed without drying.

Dyeing.—The bath should be very dilute and nearly cold at the beginning of the operation. Two-four per cent. acetic acid (30 per cent.) is added and the pieces given two ends in the liquor before any colour is added. The colour is then added in portions at each end and the bath is gradually

brought to 1.40° Fahr., when the colour will be fixed on the material and the goods ready for washing.

To Obtain the Right Results

(I) To obtain concordant results as regards shade, fastness, etc., it is necessary that the working conditions be kept as constant as possible, both as regards the amount of tannic acid used for a particular shade and the final temperature at which the dyeing is concluded.

(2) Dyeings made entirely in the cold are usually less fast

than those finished at an elevated temperature.

(3) Acetic acid is employed both to correct any hardness in the water and, by virtue of its acid properties, to restrain the dyestuff from rushing on to the fibre. Alum may be used in its place although with some dyestuffs it yields slightly different shades.

(4) For dark shades the cheaper sumac or myrabolams may be used in place of tannic acid. About ten parts good Silician sumac are equivalent to one part commercial tannic acid. Boil up with water for quarter of an hour and filter through calico. A second extraction may be made if desired.

(5) For very dark shades iron salts may be used in place of antimony to fix the tannic acid or sumac on the yarn. The iron reacts with the tannin to form a grey or black compound and this dark bottom dulls and deepens the shades considerably. The shades produced by this method are less fast than those on a tannin-antimony bottom. Crude pyrolignite (acetate) of iron is the best agent to use, as it gives the darkest bottom. The mordanted yarn is worked for 1−1 hour in an iron bath starting at 2−4° Tw., rinsed and allowed to lie exposed to the air until the deepening of shade is no longer observable. A chalk bath is sometimes given after the iron, but is not essential. Pyrolignite of iron has a rather unpleasant smell which is liable to adhere to the yarn, and, if this is objected to, 4−5 per cent. copperas (ferrous sulphate) may be used in its place.

Application in Calico Printing

Direct Printing.—The usual method of applying Basic colours in printing is by making a suitably thickened solution of the dyestuff and adding to this tannic acid, which has been dissolved in acetic acid in order that there may be no precipitation of the colour lake until the material is subjected to steaming. After steaming, the fixation of the colour is completed by passing the material through a dilute solution of a salt of antimony; tartar emetic and lactate of antimony are commonly used for this purpose. After passing through this bath, the cotton cloth printed with Basic colours is well rinsed off, soaped, washed and dried. Acetin J and H are extremely useful additions to print pastes of Basic colours, the effect being to keep the dyestuff-tannin combination in solution prior to steaming.

Dyeing on Discharged Tannin Mordant.—Basic colours are employed very largely for dyeing on discharged tanninantimony mordant. The bleached calico is padded on a mangle through a solution of tannic acid at 4 to 6 oz. per gallon and dried. When very full shades are to be dyed this operation is repeated. It is a common practice to add ammonium chloride or sulphate to the preparation at about 1 oz. per gallon to prevent "scumming" on the printing roller taking effect on the mordant. The goods are then printed with a caustic soda discharge which varies in strength with the amount of tannic acid on the cloth or the weight of the pattern. The following is a good strength for heavy dyeings: 5 gals. caustic soda (53°. Tw.), 25 lb. British gum. After printing and drying, the goods are passed through a small ager for one minute. The next process is fixation in the antimony bath, and, without drying up, the cloth is passed to the develocks.

Coloured Discharges.—Colour discharges on Chlorazol colour grounds are obtained by printing the discharge paste, to which suitable basic colours have been added, on to the dyed cloth. The cloth is first padded with tannic acid, dried, and is then printed, steamed and fixed by a short passage through a cold bath containing tartar emetic. The products suitable for use in these styles are:—Acronol Yellow TS, Auramine OS, Acridine Orange LPS and RS, Rhodamine BS, New Methylene Blue NSS, Thionine Blue GOS.

Dyes and Their Application: Recent Technical Progress By L. J. Hooley

Chrome and Mordant Colours

THE mordant colours in which the metal is incorporated into the dyestuff before marketing have been the ones which have been the most important from the research point of view during recent years. Here, although the main lines have been laid down for some time, development is still taking place, in the filling up of gaps and in the introduction of variations In the older chrome colours what development is now taking place is largely incidental and confined to improve ments in existing colours and matters of that nature. Altogether the most recent developments in the two classes are of rather a miscellaneous character, as can be seen from consideration of some of the most important of them, which are given below.

Prechromed Dyes

More than half the patent applications here deal with the application of already known or modifications of already known pre-chroming or pre-metallising methods to newly synthesised azo dyes, specially prepared for the purpose or to new sub-groups of known dyestuffs not previously known to be of interest for such purposes. As examples there are the following:

(a) Blue dyes obtained by coupling N-aryl-J-acids with

diazotised 5-nitro-o-aminophenol in alkaline solution.

These have an affinity for cotton (S.C.I.B., B.P. 289,094.) In an addition to this patent B.P. 295,944 N-acyl derivatives are used instead of N-aryl ones. J-acid derivatives are also used in B.P. 325,204, where the metallising agent is one containing more than one metal or where different metals are introduced successively. In B.P. 304,298 (C.N.M.C. and Kuhlmann) a diazotised o-aminophenol or naphthol is coupled with a pyrazolone obtained from an N-aryl-sulphonyl-arylene-

(b) Diazotised 4-chlor-2-aminophenol is coupled with a naphthol and then treated with a trivalent chromium compound; the resulting dyes which give various shades of violet,

are even dyeing and fast (B.P. 292,344 I.G.F.A.-G.).

(c) Diazotised sulphonated o-aminophenols or o-amino-naphthols (free from carboxylic acid groups) are coupled with unsulphonated monohydric phenols (also free from carboxylic acid as well as amino groups) (B.P. 325,208, I.G.F.A.-G.)

(d) 4-hydroxy-quinolines containing alkyl or other radicles in the nitrogen atom are used in B.P. 327,380 (I.G.F.A.-G.) in the synthesis of o-hydroxy azo dyes for complex metal compounds.

(e) Azo dyestuffs obtainable from tetrazotised venzidine-3:31-dicarboxylic acid coupled with aryl or aroylamino residue also contains a group such as sulphonic acid conferring solubility are used in B.P. 333,573 for treating with copper to form substantive dyestuffs.

(f) Azo dyes from diazotised 2-aminophenol-4: 6-disulphonic acid with unsulphonated components are treated

with chroming agents (B.P. 310,011).

Among methods of synthesis where one of the starting materials already contains a metal may be mentioned the use of cyanuric chloride (B.P. 298,494, S.C.I.B.). Here, with three replaceable chlorine atoms and the choice of a great number of components containing the necessary reactive amino or other groups, as well as the variety of metal com-pounds of these available, the choice is naturally very great, and the specification includes a large number of examples. This patent affords another instance of the application of cyanuric chloride in the production of complex dyes.

Combination in the dye bath between a pre-chromed triarylmethane dye and a pre-chromed azo dye is stated to give dyeings of unexpectedly good light fastness (B.P. 296,310, S.C.I.B.)

In addition to the earlier methods of incorporating the metal into the dye, later developments describe: (a) The use of a soluble salt of hydrosulphuric acid along with chromium hydroxide (B.P. 295,594, S.C.I.B.).
(b) Boiling with chromium salts of benzenesulphonic or similar sulphonic acids (C.N.M.C. and Kuhlmann, B.P.

307,871).

(c) Adding sodium sulphide with the object of reducing into groups (to amino-azo, or azoxy-groups) simultaneously with the chroming (B.P. 295,594, S.C.I.B.). In an analogous with the chroming (B.P. 295,594, S.C.I.B.). In an analogous method reduction is carried out on the metal complex (B.P. 268,754, I.G.F.A.-G.).

The use of metallising agent of a complex compound of metal hydroxide and an organic hydroxy derivative such as glycerine (B.P. 297,687, S.C.I.B.).

Chrome Printing Colours

The chrome printing colours for cotton are exemplified in only one or two of the recent patents. Disazo dyes obtained by coupling p-phenylene diamines, after diazotisation, with two molecules of a salicylic acid but with the o- and ppositions to the hydroxy group unoccupied are sulphonated, the sulphonic acid groups entering ortho to the hydroxy group. Thus p-aminobenzene-azosalicylic acid diazotised and coupled with salicylic acid and then sulphonated gives a yellow chrome printing on cotton (B.P. 289, 135, I.G.F.A.-G.). Browns are printing on cotton (B.P. 289,135, I.G.F.A.-G.). Browns are obtained by the chrome printing method by coupling resorcinol with two molecular proportions of a diazotised hydroxyaryl-carboxylic acid (B.P. 285,097, I.G.F.A.-G.). Another method for brown is diazotising aminoazo compounds of the type R¹—N=N—R²—NH₂, where R¹ is a hydroxyaryl-carboxylic acid, and R² contains a sulphonic or carboxylic acid group, and then boiling the diazo compound in acid or alkaline solution until its coupling power has been destroyed (B.P. 283,482, Durand and Huguenin).

Hydroxylarylcarboxylic acid derivatives are also used in B.P. 265,203 (I.G.F.A.-G.), these being hydroxyaminodiarylmethane carboxylic acids such as 4¹-amino-4-hydroxy-3-methyldiphenylmethane-5-carboxylic acid are used as diazotised constituents. In this way bright red and violet chrome printing colours are obtained.

Wool Chrome Colours

A diazotised mono-acetylated p-phenylene diamine sul-phonic acid is coupled with an o-hydroxy acid, rediazotised and then coupled again with an o-hydroxy acid. Products such as reddish oranges are thus obtained which dye chromed wool (B.P. 255,086, Durand and Huguenin). Olive-green to greenish-black metachrome colours—i.e., colours suitable for dveing with the chrome in the bath, are synthesised from 2: 6-dihydroxynaphthalene-3-carboxylic acid by coupling with a diazotised o-hydroxyaminoaryl body, very good fastness to washing, potting and fulling being claimed.

Some miscellaneous items of interest are the chrome dyes

from barbituric acids such as the following:

$$NH < \begin{array}{c} CO.NH \\ CO.CH_2 \end{array} > CO.$$

which are used in the production of o-hydroxydiazo compounds (B.P. 257,797, S.C.I.B.). Barbituric acids are also used in G.P. 447,754 (I.G.F.A.-G.).

G.P. 447,754 (I.G.F.A.-G.).

A heavy chromium mordant is fixed on cotton or silk by treating with a mixture of a chromate or bichromate of a fixed alkali and sulphoxylate body in the absence of ammonia (J. L. Hankey, B.P. 324,358.)

Scottish Market Report

The dyer's strike has seriously interfered with business in the dyeing and printing trades in certain districts in Scotland. This has arisen out of negotiations between the West of Scotland employers and the Amalgamated Society of Dyers following the proposal to reduce wages by 5 to 10 per cent. Among works affected were the United Turkey Red Co., and other members of the Vale of Leven branch of the Bleachers' and Dyers' Union. At Paisley there was for some time considerable doubt as to whether there would be a stoppage, and even now it is only partial. Conditions are already rather more difficult in Scotland than farther south, owing largely to greater distance from the Lancashire and Yorkshire textile centres, and this stoppage does not tend to improve matters.

Notes on the Thionol Colours

THE I.C.I. range of Thionol Colours now numbers 63 distinct varieties, each capable of variation in depth of tone, and the bound volume of pattern cards, showing their application in two strengths, is a miniature colour library in itself.

two strengths, is a miniature colour library in itself.

Thionol colours, with certain exceptions, are usually dyed at or near the boil for ½-1 hour. When medium or dark shades are being dyed a considerable saving is effected by working in standing liquors. Approximate quantities required for the replenishments of the dye bath are as follows:—Dyestuffs and sodium sulphide, ½-½ of the initial amounts; soda ash and common salt, ½-0-1 of the initial amounts. The density of the standing liquors rises gradually and should be tested from time to time by means of a Twaddle hydrometer. If the liquor tests above 7-8° Tw. for medium shades, or 10-12° Tw. in the case of deep shades and blacks, no further additions of salt should be made.

It is an unfortunate fact that the sulphur yellows are comparatively fugitive to light unless they are aftertreated with metallic salts. Fortunately, the extraordinary fast to light direct dyestuffs, Chlorazol Fast Yellows BS and BNS, dye very satisfactorily from a sulphide dyebath, and are used extensively, in combination with Thionol Green BS, for the production of fast to light green shades. The fastness to washing of Chlorazol Fast Yellows BS and BNS is very good. particularly as regards the staining of adjacent white. peculiarity of the sulphur colours is that no red member of the series has been marketed, and it is with a view to filling this gap that Chlorazol Fast Red 10BS is manufactured. This product, which is recommended for shading purposes only, will be found to possess satisfactory dyeing properties. The Chlorazol dyestuffs are pasted with cold water previous to dissolving by the addition of boiling water. The solution is then added to the prepared dyebath and the dyeing process is conducted in the normal manner.

Thionol dyestuffs on the cotton fibre act as mordants for basic dyes, hence basic colouring matters are employed in small percentages for topping Thionol dyed bottoms in order to brighten and vivify them. The dyed material is entered into the cold bath, charged with the requisite amount of dyestuffs and 2–5 per cent. of alum or acetic acid, and after working for 10–15 minutes, the temperature is raised gradually to 140° F. (60° C.) in order to ensure thorough fixation.

The freshly dyed shades of the Thionol Corinths and Thionol Red Browns gradually become redder and brighter on exposure to the atmosphere. This change is due to their lack of fastness to acids, and the final shade can be attained by rinsing the dyed material in a cold bath containing a little acetic acid.

Thionol Green BS and Sky Blue FFS are very widely used in conjunction with Chlorazol Fast Yellows BS and BNS for the production of very fast to light green shades. The shades produced with them become bluer and brighter on ageing, while a similar, but more pronounced, effect can be obtained by an oxidation aftertreatment as described on page 4.

With Thionol Green 2GS and Thionol Brilliant Green GS, the yellowest, brightest and fullest shades are obtained by dyeing at 120° F. (50° C.). With Thionol Sky Blue 6BS and PS, the brightest and greenest sky-blue shades are obtained by dyeing at or below 120° F. (50° C.). Heavy shades are characterised by a red bronze similar to that obtained with Indigo, and this property is utilised for the production of goods intended for Eastern markets. In the case of Thionol Blue 2BS and Indigo Blue 2RS, an excess of sodium sulphide, or too high a temperature, tends to the production of bronzy dyeings and should be avoided. The temperature recommended for dyeing is 120-140° F. (50-60° C.)

temperature recommended for dyeing is 120–140° F. (50–60° C.)
Thionol Navy Blues XXS, XX2B and VS give blue black shades which, on ageing, become bluer and brighter and, on aftertreatment with sodium perborate, are converted into full navy blues. They are recommended as a basis for black on yarns which are afterwards to be chrome cross-dyed, as they retain their blue tone during this process.

Thionol Black GGS differs chemically from the usual sulphur black. It is exceptionally level dyeing and for this reason is particularly recommended for use in greys and pale combination shades on ordinary cotton. It possesses exceptional non-bronzing properties when used for the production of black on mercerised cotton.

In connection with Thionol Blacks it is pointed out that the tendering of cotton dyed with sulphur black is a phenomenon not thoroughly understood. It appears to be entirely confined to full shades of sulphur black and most often occurs in material shipped to hot climates. An examination of the tendered material reveals the presence of comparatively large quantities of sulphuric acid, apparently derived from the oxidation of the decomposition products of sulphur black. One method of prevention in general use is the aftertreatment of the dyed material with acetic acid and bichrome, followed The object of this treatment is the by thorough rinsing. formation and the elimination of the oxidation products before the dyed material leaves the dyehouse. Further, that full shades of sulphur blacks should never be aftertreated with copper salts; that the dyed material should be thoroughly dry and thoroughly cooled off before packing and, if for shipment to hot climates, that air-tight packages should be used which should be stowed away from the boilers. Stoving, cross-dyeing or scrooping of mixed materials containing sulphur black dyed varns increases the risk of tendering.

United States Dyestuffs Preliminary Report of Census

The preliminary report of the Census of Dyes and other Synthetic Organic Chemicals, 1930, which was released on April 15 by the United States Tariff Commission, shows a production of 86,585,000 pounds of dyes in 1930, which represented a 22 per cent. decrease from the peak output in 1929. Sales amounting to 89,867,000 pounds, valued at \$38,670,000, represented a decrease of 15 per cent. by quantity and 16 per cent. by value compared with sales in 1929. This decrease of 15 per cent. represented domestic dyes of all classes; there were decreases of only 2 per cent. for vat dyes (other than indigo), 5 per cent. for lake and spirit-soluble, 6 per cent. for direct, and 10 per cent. for basic dyes, but heavy decreases occurred in the mordant and chrome class (30 per cent.) and sulphur dyes (24 per cent.).

Sulphur dyes (24 per cent.).

The decrease in production and sales of dyes in 1930, as compared with 1929, was less than the decrease in either of the depression years 1921 or 1924. A 55 per cent. decrease in production and 59 per cent. decrease in value occurred in the depression year of 1921 over 1920. A new production record was reached in 1923 followed by a 27 per cent. decrease in production and a 26 per cent. decrease in sales value in 1924, and since 1925, production and sales have gradually increased each year to a new record in 1929.

Production and sales in 1930, according to classes, are tabulated below:—

	Sales (lbs.)	Production (lbs.)
Acid colours	10,954,000	10,743,000
Basic colours	5,058,000	4,991,000
Direct colours	19,250,000	17,966,000
Lake and spirit soluble	2,490,000	2,553,000
Mordant and chrome	3,236,000	3,121,000
Sulphur colours	16,053,000	14,418,000
Vats (including indigo)	32,172,000	32,208,000
Unclassified	654,000	585,000
Total	80.867.000	86.585.000

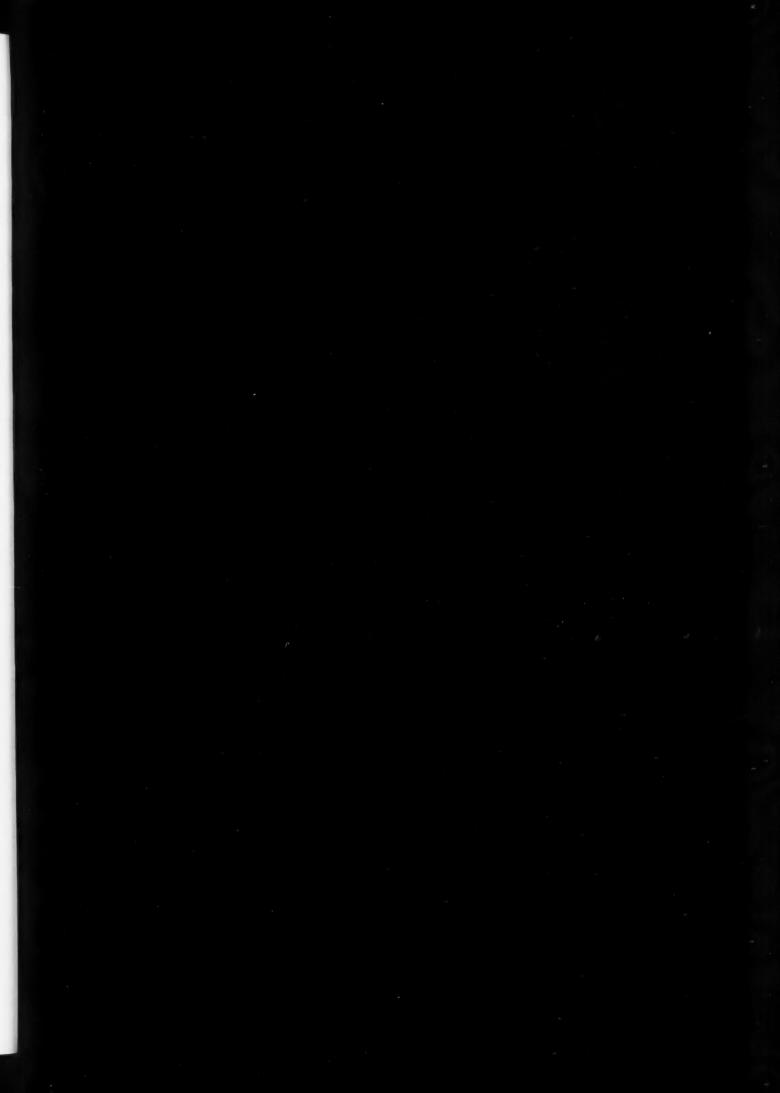
Indigo, the leading colour made in the United States, shows an average sales price of 13.7 cents in 1930, as compared with 14.9 cents in 1929 and 14 cents in 1928. The pre-war import price was 15 cents per pound. Sulphur black, the next leading colour, shows an average sales price of 12.2 cents in 1930, as compared with 14 cents in 1929.

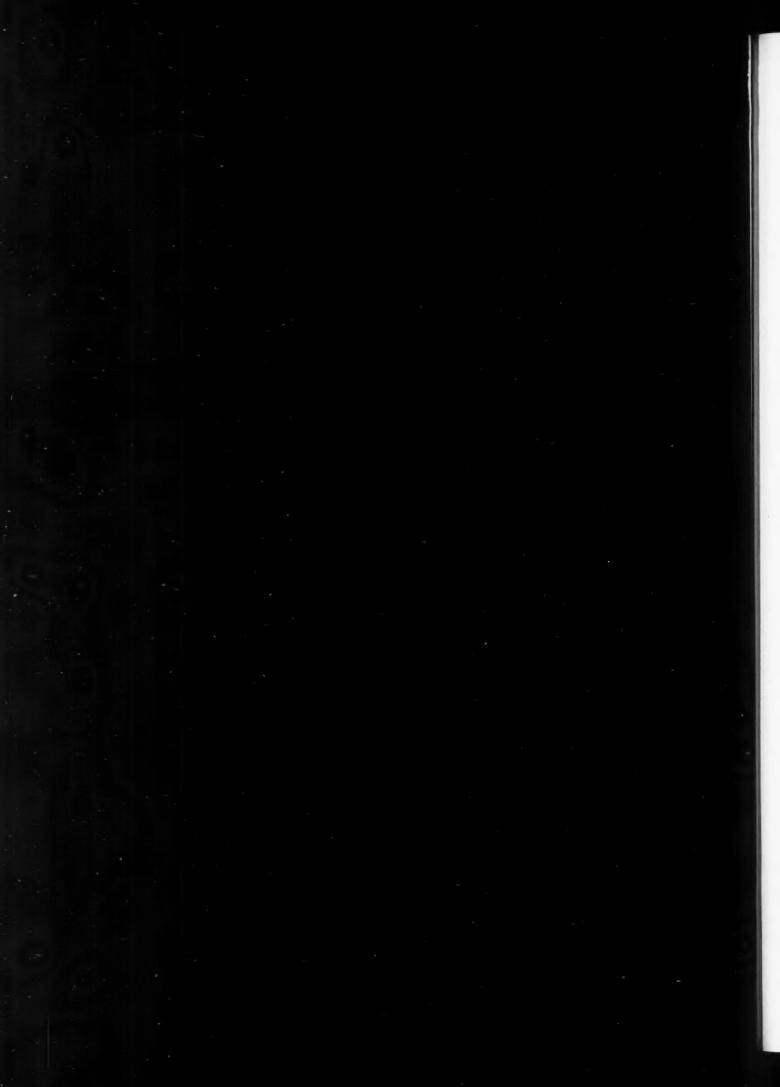
Total exports in 1930 were 28,062,940 lbs., valued at

Total exports in 1930 were 28,062,940 lbs., valued at \$6,209,811; this represented a decrease of 18 per cent. in quantity or 15 per cent. by value, as compared with figures for 1929, and is the first decrease in exports by quantity since 1924. Imports during 1930 were 4,114,882 lbs.; with a foreign invoice value of \$3,500,154; a decrease of about 36 per cent. compared with 1929.

Scottish Tweed Trade Delegation

THE Scottish tweed trade delegation visiting Europe left in the early part of last month and are to visit the principal cities and capitals. The delegation is intended to supplement the work of the similar one which recently set out to tour Canada and the United States.





Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.A. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

A New Solochrome Brown

Solochrome Brown PS, the latest addition to the I.C.I. range of Solochrome colours, is a very rich and striking shade shown on Botany stubbing and worsted piece; the afterchrome process leaves a somewhat deeper effect than the metachrome process. The new colour is suitable for application to all types of woollen and worsted materials where reddish-brown shades of very good to excellent fastness properties are required. It fulfils all the demands regarding fastness properties required in the various branches of the wool dyeing industry; its very good fastness to wet steaming and carbonising are points of particular interest to loose wool and piece dyers. It possesses very good solubility and is of value for machine dyeing. It may be applied to natural silk, either by the afterchrome or chromium chloride mordant process, giving shades of very good fastness to water and washing. It is also of interest for wood and carpet yarn printing, giving shades of good fastness to soaping.

Solochrome Brown PS possesses very good affinity for the wool fibre and the dyebath may be completely exhausted by addition of acetic acid. Under the conditions prescribed dveing takes place at a uniform rate and the colour shows no tendency to rush on to the fibre. It is advisable to add the full amount of acetic acid to the dyebath at the commencement of the dyeing operation in order to obtain the most even and regular results. The shade is readily developed with bichromate and quite satisfactory results may be obtained without addition of formic or sulphuric acid. In order, however, to ensure complete development and maximum fastness it is recommended that a little formic or sulphuric acid be added to the exhausted dyebath. The colour may also be applied by the chromate (metachrome) or chrome mordant processes. The former process gives somewhat yellower and weaker shades and in both cases somewhat inferior fastness to potting compared with the afterchrome process.

A Brilliant New Blue

A blue of unusual brilliance and depth, which seems equally good on woollen yarn, spun silk yarn, worsted piece and worsted piece with cotton effects, has been produced by Imperial Chemical Industries as an addition to their acid colours. It is named Disulphine Blue FFS It gives brilliant pure blue shades of very good fastness to stoving, decatising, carbonising and acids It possesses excellent level dyeing properties and leaves cotton effect threads white. It is of special value in piece dyeing either as a self shade or as a component of light mode shades. Its excellent levelling power makes it eminently suitable as a shading colour. The colour is of interest for dyeing wool and fur felt hat bodies and is extremely valuable for shading purposes, giving excellent penetration. It is of interest to printers as a ground shade for the production of discharge effects and as an illuminating colour when used with stannous chloride discharges. It dves the wool or silk in union materials from an acid dyebath and leaves cotton, viscose, and acetate silk unstained. Owing to its brilliant shade and very good levelling power it is of special interest for dyeing natural silk, giving shades of

fair fastness to water, washing and light.

Disulphine Blue FFS is an extremely level dyeing colour

and gives perfectly even shades when added to the hot dye-liquor. When dyeing is commenced at or about 105° F. (40° C.) the colour is slowly absorbed as the temperature is raised, the maximum affinity being obtained at or near the boil. The dyebath is not completely exhausted. When applied to natural silk from a sulphuric acid dyebath the maximum affinity is obtained below the boil.

Reviewing the Dyestuffs Act

A very full and well informed review of the Dyestuffs Act in Britain appears in Industrial and Engineering Chemistry, the organ of the American Chemical Society, from the pen of Dr. E. F. Armstrong, whose experience as managing director of the British Dyestuffs Corporation during perhaps the most critical stage of its existence gives special value to his judgment. It is universally agreed (Dr. Armstrong states) that the main object of the Act has been achieved and a substantial dye-making industry built up in Great Britain. The dyestuffs produced now represent about 93 per cent. of the quantity consumed in the country, and about 81 per cent. of their sale value. A very wide range of dyestuffs not previously made has been placed on the market, and their quality is fully equal to that of any foreign manufacture, though many important dvestuffs have not vet been domestically produced. Vat colours were not made in Great Britain in 1913, whereas in 1928 the production of this series alone, exclusive of indigo, was 64 per cent. of the country's requirements.

The Technical Side

On the technical side Dr. Armstrong recognises that, compared with pre-war periods, there has been very little production of an original character in dyes either on the Continent or in Great Britain or throughout the world. Thus not many new colours, in the sense that they have not been manufactured anywhere else in the world, have been included in the British products, with the exception of colours for the dyeing of various types of artificial silk. The latter is undoubtedly the outstanding achievement of British makers, and the foreign dyestuffs makers have followed the British in the manufacture of these products. Indeed it may be claimed that the performance chronicled in the following paragraphs is highly meritorious.

Ionamine Dyes.—This range of entirely new products was discovered and elaborated by the British Dyestuffs Corporation, Ltd., in 1922, being a series which temporarily possess the character of soluble products but have no dyeing affinity for cotton. During the dyeing process they are changed into soluble products and have a direct affinity for cellulose acetate but not for any of the other textile fibres.

textile fibres.

Duranol Colours.—The same firm marketed a range of basic anthraquinone derivatives under the above description which are primarily intended for the dyeing of acetate silk. All these products are characterised by their generally excellent fastness to the usual general light, washing etc.

are characterised by their generally excellent fastness to the usual agencies, light, washing, etc.

Closely related to the above are the Celatene Colours, introduced by Scottish Dyes, Ltd., possessing the same affinity for acetate silk and equal properties

and equal properties.

S. R. A. products were put on the market by British Celanese,
Ltd., and are mainly insoluble azo dyes in a finely divided state
which are primarily intended for, and used in, the dyeing of cellulose
acetate silk.

The Dispersol Colours are products of similar properties and characteristics to the afore-mentioned but introduced by the British Dyestuffs Corporation for the dyeing of acetate silk.

Caledon Jade Green G, introduced by Scottish Dyes, Ltd., is by

far the most important addition to the series of vat colours during the last ten years, and is an outstanding feature in a range of colours especially noted for their brilliance of tone and excellent fastness.

especially noted for their brilliance of tone and excellent fastness. The Icyl Colours represent a special type of azo dyes which possess the great feature of dyeing level shades on uneven viscose.

The Chromazol Colours are a new series of dyestuffs specially suitable for calico printing and possessing a special feature in that the alteration in shade, which takes place when the product is fixed with the mordant, is only very slight, which is contrary to the usual development of chrome colours under similar circum-

The Training of Chemists

Finally it is not surprising to find so sound and convinced a chemist as Dr. Armstrong emphasising the chemist's part. Technical efficiency is very largely dependent upon the employment of chemists of sound training and wide experience in the highly complicated technique of manufacture of organic chemical products. During the past ten years a large number of chemists have gone out from universities and other educational institutions to the various dyestuffsmanufacturing concerns in this country to apply and adapt their academic knowledge and training to the needs of the industry. Many of the works chemists, however, are as yet too young in experience fully to have explored all the intricacies of efficient production, even in connection with products the manufacture of which is long established. The national importance of the dyestuffs industry as an outlet for British brains and a field of employment for trained chemists and chemical technologists cannot be too strongly stressed. Any restriction of this field would lead to a diminution in the numbers trained with a repercussive effect on the facilities for instruction and research in

organic chemistry. This would have an adverse influence, not only on other branches of the organic chemical industry, such as those engaged in the manufacture of medicinal products and other fine chemicals of vital national importance, but on many industries outside the purely chemical field, the progress of which requires the services of highly trained organic chemists.

Without venturing on prophecy, he confidently declares that supremacy in the organic chemical industries will largely lie with that country which has the right men—directors with sound chemical knowledge and commercial ability coupled with breadth of outlook and enterprise, and chemical investigators having the heaven-born gift of scientific discovery and a love of research for its own sake.

Dyestuff Licences for May

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 511, of which 429 were from merchants or importers. To these should be added six cases outstanding on April 30, making a total for the month of 517. These were dealt with as follows:—Granted, 481 (of which 474 were dealt with within seven days of receipt); referred to British makers of similar products, 25 (of which 24 were dealt with within seven days of receipt); outstanding on May 31, 11. Of the total of 517 applications received, 498 or 96 per cent. were dealt with within seven days of receipt.

The Dyeing of Leather, Fur and Hair By L. J. Hooley

THE colouring of wool and silk is generally considered along with the other textile fibres, while hides, fur, etc., and similar materials form a distinct branch of the dyeing art. The word art is apt here as these materials differ from the fibres in being used, roughly speaking, in the piece as grown, which means they show greater variations than the textile fibres which have had what may be called an averaging treatment in their manufacture. Further, it is necessary in many cases to preserve the unique characteristics of the substance, as these are what give them their special values. Variations in the original are partly removed by the various preparatory treatments which precede dyeing, but as these must not be too drastic, uniformity cannot always be obtained, and also defects or inequalities may easily be increased. Roughly speaking, owing to the similar protein bodies which they contain, their dyeing follows along similar lines to wool and silk, the same classes of dyestuffs being suitable. The mechanism, however, is much less well known, and the theory of dyeing has received much less attention.

Theory of Leather Dyeing

In this connection a paper by H. Salt on the theory of leather dyeing (J. Soc. Dyers Col., 1928, 134) is of great Taking the two main tanning methods of converting the hides to leathers—the mineral and vegetable tannagesthe author shows the relation between the two processes of tanning and dyeing. The protein substances in the hides and skins show like wool an amphoteric chemical character, and, in fact, are more reactive than in wool. In mineral tanning with basic salts of chromium, or less frequently aluminium, the acidic groups take up the tanning salts, and as would be expected, the remaining basic groups give the leather good affinity for acid and direct colours. Where, as is frequently the case, tanning is used on the chrome leather prior to dyeing, the attraction for acid colours is correspondingly reduced and that for basic colours increased. On the other hand, as the vegetable tannins are all acids, these attach themselves to the basic groupings in the skins, leaving the acid ones to give affinity for basic colours, which affinity is enhanced by the acid character of the tannins themselves. An apparent

anomaly, in the taking up of acid colours by vegetable leathers is explained by the ionising of loose tannin in the dyebath with replacement of these acid groups by those of the acid colour. This process is found to be much dependent on the pH value of the dyebath.

It will be seen from the above that the dyeing process is what may be called in ordinary parlance a chemical one, but the author rightly points out that colloidal, electrical adsorption and chemical theories are all, in the modern view, simply different ways of looking at the same thing, the process being in each case dependent on potential differences. The above paper may be very conveniently read in conjunction with another in the same volume (page 225) in which M. C. Lamb describes the dyeing of gloving and clothing leathers, with practical details.

Synthetic Tanned Leathers

G. E. Knowles also discusses the dyeing of synthetic tanned leathers (J. Soc. Leather Trades' Chem., 1930, 562). Basic dyes are stated to be readily fixed by synthetic tanned leather because the tannin is a good mordant, while acid dyes are divisible into four classes according to their effectiveness. Acid dyes with two or more basic colours give the fullest shades. A table of suitable dyes is given.

Some new dyes for leather recently described in the patent literature may be mentioned. A special feature of these is the use made of resorcin and its derivatives. Resorcinol or α - or β -resorcylic acid is coupled with o- or p-toluidine, p- or m-xylidine or their sulphonic acids, one molecule of the former being used with two of the latter

(cf. Prague alizarine yellows) (Bottomley and Emerson, Ltd., and Earnshaw, W. D., Brit. Pat. 316,822).

(Continued on page 34).

Basic Intermediates for Dyestuffs: No. XLIII.—Phosgene

It is only a little more than a hundred years ago since John Davy, the brother of the more famous Humphrey Davy, discovered that carbon monoxide would combine with chlorine under the influence of sunlight to form a new gas which he christened "phosgene," and which was destined to be put to many uses. In the dyestuffs industry phosgene is a valued intermediate on account of its ability to function as an acid chloride in the Friedel Craft synthesis, and also for the preparation of acid chlorides from the sodium salt of the corresponding acid; instances of these uses will be discussed in detail later.

Manufacture of Phosgene

When carbon monoxide and chlorine are mixed in the presence of sunlight they rapidly combine to give phosgene, but

it can readily be seen that a process which depends for its success upon such intense irradiation can have little success commercially. The other methods which are available, namely, the dry distillation of trichloracetic acid.

Cl₃.C.COOH=HCl+CO+COCl₂ the interaction of chlorine monbisulphide. carbon

method

oxide with $CS_2 + 3Cl_2O =$ 2.SOCl2+COCl2 and the decomposition of carbon tetrachloride with fuming sulphuric acid which takes place according to a variety of reactions, are all usecommercially. The sulphuric acid and carbon tetrachloride process was operated in Italy during the war as an

for the production of

phosgene for use as a

poison gas, but all

emergency

such processes are economically unable to compete with the process involving the direct combination of chlorine and carbon monoxide at the surface of a suitably prepared solid catalyst.

The revolutionisation of the general method for preparing phosgene was due to Paterno, who in 1877 showed that, even in the dark, chlorine and carbon monoxide would unite instantaneously in the presence of animal charcoal, the yield of phosgene being almost quantitative. This is the basis of all modern methods. The type of charcoal used depends on the plant in which it is to be used; the majority of plants use the charcoal known as "Harrison's," which is obtained by heating crushed and graded degreased bones in sand, at a low red heat, until all the products of decomposition have been removed; when this stage is reached the sand is removed by screening, and the crude charcoal sifted to obtain pieces of about 3 in. size. These are treated with acid to remove the calcium salts, washed free from acid with water and "activated" by heating in closed clay retorts at a bright red heat for a considerable time.

The two processes used for production of phosgene are designated "dilute" and "pure" according to the raw materials used. If air is used as the raw material supply of oxygen then the carbon monoxide or producer-gas mixture contains only about 20 to 25 per cent. of carbon monoxide; on the other hand, in the "pure" process the use of oxygen in the producer enables a comparatively pure carbon monoxide to be used in the catalyst chambers. The relative merits of the two processes turn on the following points. In the case of the "dilute" process there is a larger consumption of raw materials per ton of phosgene produced; thus, 30 per cent. more coke and 1 per cent. more chlorine are required together with large quantities of tetrachlorethane (or an equivalent

solvent) for scrubbing out the phosgene. Part of this tetrachlorethane is lost (about ½ cwt. per ton of phosgene), and must be added to the cost of production. Further, there is only 1.5 per cent. of impurities in the phosgene prepared by the "pure" process as against 3 per cent. in that from the "dilute" process. Contrasting with these points, we have the fact that the process using "pure" carbon monoxide requires a plant for the production of oxygen by liquefaction and fractionation; requires a higher grade of coke; caustic soda for purification; more elaborate plant, and more working power per ton of phosgene produced. It was shown during the war that the " pure " process on a large scale could produce phosgene more cheaply than the other.

The operations in the production of phosgene are :-

(1) Preparation of raw materials.

Oxygen: by liquefaction and fractionation.

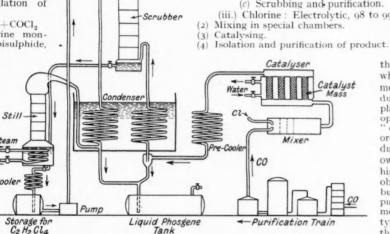
(ii.) Carbon monoxide:—
(a) Coke drying plant.

(b) Producers.

(c) Scrubbing and purification.

(iii.) Chlorine: Electrolytic, 98 to 99 per cent. purity.

In the first stage, the only operations which call for comment are the producers and scrubbing plant. Unlike the operation of the "dilute" plant, the ordinary type of producer cannot be used, owing to the very temperature high obtained by the combustion of coke in pure oxygen. The pure oxygen. most satisfactory type of producer for the purpose of this usually plant is arranged



PLANT FOR PRODUCTION OF PHOSGENE BY CATALYTIC PROCESS

groups of ten small producers each about 2 ft. in diameter and 5 ft. high. The oxygen is fed in from the oxygen plant, through water-cooled tuyères, and the exit tube is also water The producers are provided with a refractory lining, which lasts with continuous operation for several months. The purification train is in three sections: First, a rotary spray dust catcher to remove the fine particles which are unavoidable in almost any type of producer; secondly, a caustic soda scrubber to remove carbon dioxide in which the gas is subjected to a falling shower of the soda solution, and is also forced to bubble through it, and finally an acid scrubber to remove water.

The mixing of the chlorine and carbon monoxide is an important operation; bad mixing, or an error in adjustment of the relative amounts of the two gases not only gives rise to a waste of gas, but in the case of an excess of chlorine it may lead to the production of products other than phosgene. The mixers consist of cylindrical lead-lined vessels into which the two gases are passed by converging, narrowed, orifices. The gases are passed through a meter before entering the The mixer is also provided with a number of forated lead plates set across the diameter, which assist the mixing of the gases.

Catalyst Chambers

In the "dilute" process a very simple type of catalyser was found to be suitable, namely, a short tower filled with perforated shelves upon which the activated charcoal was placed. On the other hand, when this type of catalyser was used in the "pure" process, the local evolution of heat was so great that the lower layers of charcoal became bright red hot, and rapidly lost their activity; in addition to which the dissociation of phosgene at these temperatures is considerable.

The usual type of catalyser now in use consists of two chambers, an upper and a lower connected by a series of short tubes of comparatively small diameter (3 to 4 in.) and not more than 2 ft. long. These tubes are closed by a perforated diaphragm and contain the catalyst. They can be water-cooled from the outside. The mixed gases are admitted to the lower chamber and in order to escape through the vent in the upper chamber they must traverse the catalyst tubes, in which combination takes place. The gas which leaves the catalyst chamber has a temperature of about 160° C., and is run through a pre-cooling coil surrounded by water; by this means the temperature is reduced to 40° C., after which operation the gas is cooled in brine coils to -16° C., when most of the phosgene condenses. The residual phosgene is extracted by scrubbing the gas with tetrachlorethane, the solution of phosgene in tetrachlorethane being gently steamheated in a still with a short column.

The general disposition of the apparatus is shown in the accompanying diagram. The gas which escapes from this plant still contains enough phosgene to render it unfit for discharge into the atmosphere; but this residual phosgene may be removed by bubbling through a strong solution of sodium phenate, or alternatively (and more cheaply) by passing over a mixture of arsenious oxide and charcoal in iron tubes heated to 200° C. In the latter case, the phosgene converts the arsenious oxide to arsenic trichloride, which is volatile and distils off; the "tail-gas" may then be discharged into the atmosphere.

Uses of Phosgene

Although many uses of phosgene are known, they are not easy to bring together in a series of classes, so that the manufacture of one of the more common intermediates through the agency of phosgene will be discussed in detail, as typical of many. When phosgene is allowed to react with dimethylaniline, the reaction takes place in two stages, with the formation, first, of p-dimethylaminobenzoyl chloride (1), which if allowed to react with a further molecule of dimethylaniline, gives the compound tetramethyldiaminobenzophenone, a substance more often called "Michler's ketone," after the inventor. The method originally given by Michler serves at the present time to prepare this compound. The dimethylaniline (50 lb.) is placed in an enamelled autoclave and the phosgene is passed in until the container has decreased in weight 20 lb. Almost all this will have been absorbed by the amine with the formation of the acid chloride (1).

$$(CH_3)_2N$$
 \longrightarrow $(CH_3)_2N$ \bigcirc CO CI \longrightarrow (I) \bigcirc $(CH_3)_2N$ \bigcirc $(CH_3)_2$ \bigcirc $(CH_3)_$

The autoclave is then shut down and raised to 100° C. for a period of 5 to 6 hours, when the second reaction will have taken place with the formation of Michler's ketone (2). After cooling the autoclave is blown with steam to remove any unchanged dimethylaniline, and the residue of the ketone purified by solution in acid and reprecipitation with alkali. The recrystallised product melts at 172° C.

Bibliography

Davy, Phil. Trans (1812), 144. (2) Paterno, Gaz. Chim. Ital.,
 233. (3) Dyson, Chem. Reviews, IV (1927), 109-165. (4) Michler,
 Berichte, 9, 716. (5) Hofmann, Berichte, 18, 770.

Immunising Cotton

WITHIN the past few years several methods for immunising cotton have been discovered, and many of these depend on the interaction between alkali-cellulose and an acid chloride. It is now claimed that the immunised cotton produced by means of allyl bromide is more durable than the others, since, if hydrolysis occurs in the product during storage no acid is formed which is capable of effecting "tendering" or loss of strength.

The Dyeing of Leather, Fur and Hair

(Continued from page 32)

Further dyes from resorcinol derivatives are described in Brit. Pat. 313,927 (I.G.F.A-G.), a diazotised 2-chloro-4-amino-1-methylbenzene-6-sulphonic acid being this time coupled, and the dyes, which are monoazo dyes, giving yellow shades on chrome leathers. Among the substituted resorcinols used are the 1:3-dioxybenzene-2:4-dicarboxylic acid dimethylester and 1:3-dioxynaphthalene, the following formula showing the type of dye obtained.

Azo dyes in which resorcinol has been used have their affinity for leather increased, and that for wool or silk destroyed by treating with air in dilute ammonia at $70-80^{\circ}$ C. (Geigy, Brit. Pat. 306,447).

Removal of Grease from Tanned Leather

Treatment with hydrogenated naphthalene such as tetralene is recommended for improving the removal of grease from tanned leathers and assisting penetration. The tetralene is preferably emulsified, a ricinoleate or hydrogenated phenol soap or similar substance being used for this purpose (M. C. Lamb Brit Pat 255 555)

Lamb, Brit. Pat. 255,555).

Reminiscent of the complex metallic azo dyes recommended during recent years for wool, is the suggestion to mordant leather with complex metal compounds of phenol or amines, containing sulphonic acid groups. An example details a mixture of H acid (1-amino-8-naphthol-3: 6-disulphonic acid) with chromium hydroxide, anhydrous sodium carbonate, sodium acetate and potassium hydrogen sulphate (V. Casaburi, Swiss Pat. 114,271). Sulphite cellulose liquor is already known as a protecting agent for animal substances, and in Brit. Pat. 264,146 it is recommended for addition in treatment with chromium compounds in processes distinct from the ordinary dyeing and mordanting ones (I.G.F.A-G.). Another protecting agent for wool, silk, fur, etc., is dimethylol urea, CO(NH.CH₂OH)₂, this being applicable in both acid and alkaline baths (B.D.C., R. S. Horsfall and L. G. Lawrie Brit. Pat. 285,554).

Precautions in Dysing Hair

Special precautions are necessary for dyeing hair *in vivo* (to borrow a medical expression), owing to the necessity of avoiding any chance of skin disease. A. Jinno (Brit. Pat. 322,972) recommends the formation of the tannate when using bases such as *p*-phenylenediamine. One part of this diamine may be mixed in 4 parts of tannic acid and starch, boiled with water and then pasted with hydrogen peroxide. The starch is added to make it easier to remove the dye from the skin after use. Another composition recommended with bases, is a mixture with soap and glycol, these being suitable for shampoo dyes (W. Kritcheysky, U.S. Pat. 1,663,202).

mixture with soap and glycol, these being suitable for shampoo dyes (W. Kritchevsky, U.S. Pat. 1,663,202).

The use of catalysts which act like peroxydases and determine the decomposition of the peroxide is recommended by E. Schueller (Brit. Pat. 307,840). Oxidation is then effected without actual liberation of gaseous oxygen. A great variety of suitable substances are mentioned, such as metal salts, colloidal metals and extracts of vegetable substances. In a modification of the process (Brit. Pat. 307,732) an auxiliary agent is also added. Such agent being to help rapid precipitation of the products of oxidation, chlorides of metals may be used, these either acting physically or by forming metallic complexes as well as aiding fixation and improving the shade.

For general purposes, a considerable variety of shades can be obtained by the oxidation of p-aminophenylnaphthylamine salts. p-Aminophenyl- β -naphthylamine alone gives a bluegreen, but with the addition of a copper mordant a blue-black. By substituting the α -isomeride, redder shades, e.g., red violet and corinth result. From the first mentioned, with the addition of a hydroxy group in the 6-position, a grey is obtained (I.G.F.A-G., Brit. Pat. 290,126).

Cleaning and Inspection of Vessels Preparatory to Repair in the Dyestuffs Industry

By G. B. Jones

(Works Manager, Dalton Works, Huddersfield, Imperial Chemical Industries, Limited)

We give below the text of a paper presented by Mr. G. B. Jones, works manager of the Dalton Dyeworks, Huddersfield, at the Chemical Section of the recent "Safety First" conference at Leeds.

Just as the dyestuffs industry involves the manufacture of a large number of products, so also the methods used for cleaning vessels in this industry are complicated and cover a large range. It has been found, to ensure that at all times only fully recognised safe methods are used without waste of time and effort, that the problem had to be tackled in two general The first has been the drawing up and issuing of general works instructions which lay down the procedure for the inspection and certification of all vessels before a man is allowed to enter. The second has been centred in the drawing up of different detailed instructions for each vessel or group of vessels, as the conditions in the factory are so varied. in many cases the instructions have had to be varied, not only for different vessels, but also for different products which from time to time are manufactured in the same vessel or group of vessels, the amount of detail necessary in each case depending, of course, on the nature of the chemicals involved.

In order to show how these two general problems have developed, I give below extracts from a general order which has been drawn up under the title of :—

"Regulations governing the issue of certificates of safety for men entering closed vessels or plant where gas or fume is liable to be present.

A certificate of safety in book form, in triplicate, and designated Form No. 85, must be used for certifying that all closed vessels and plants are free from gas or fume as required under the Chemical Works Regulations, 1922. In cases where this certificate cannot be given, the procedure laid down under the Chemical Works Regulations, 1922, must be followed, and a man permitted to enter only if he is wearing breathing apparatus and a life-belt. The exact procedure to be adopted in this case is given on the inside of the cover of the book of certificates of safety.

The exact method of cleaning any particular piece of plant or closed vessel is a matter with which the manager of the department is concerned, and he is responsible for seeing that proper methods are used.

The method of testing the atmosphere of the vessel after it has been cleaned is also the concern of the manager of the department. A supply of white mice is available at the fire station, and these should be used to test the atmosphere of all closed vessels where this method of testing is The responsibility for devising a suitable test and seeing that it is carried out rests with the manage

A certificate of safety is required by the Chemical Works Regulations, 1922, to be signed by a responsible person, who must also be the person examining the vessel, and for this purpose any person employed on the factory in the capacity of a chemist should be considered a responsible person for signing any certificate of safety. In order to meet cases where it is impossible or inconvenient for a chemist to carry out the inspection personally and sign the certificate, an assistant chemist, laboratory assistant, foreman or charge hand may under certain circumstances be considered a person of responsibility subject to the following conditions.

Responsibility for Issue of Certificate

Here follow in the regulations detailed instructions as to who shall sign the certificate in certain definite circumstances, and in the case of the lower ranks, such as foremen and charge hands, before they are permitted to sign, their name must be on an approved schedule and their authority is confined strictly to certain specified vessels, so that there is no danger of anyone except fully competent persons signing the certificate. Under no circumstances is a person permitted to sign for another, and every certificate must be signed by the person actually carrying out the inspection and issuing the certificate.

The instruction then goes on to detail exactly how each of the three copies of the certificate are to be disposed of, and in order to ensure that repairs are carried out as quickly

as possible, one copy of the certificate is handed by the manufacturing department foreman to the engineering department foreman who is to carry out the work; this is taken as the actual physical certificate which permits the man to enter the vessel, the special point of this part of the order being to ensure that the fact that special safety precautions are being carried out is no excuse for delay or involved methods. Our experience has shown that the need for safety is often used as an excuse for delay and waste.

The general order then goes on:

This certificate shall be used to cover all conditions where safety has to be certified, and to meet special cases it may be necessary to add special remarks on the certificate certifying, for instance, that a flame can be used. remarks should be as brief as possible.

This general order must be enforced strictly, and in cases of doubt the alternative method of obtaining entry to vessels should be put forward and authority obtained for the use of breathing apparatus and life-belt.

Special points which require careful consideration in drawing up the above instructions centre round the following

Co-operation Between Manufacturing and Engineering Staff

It is essential that there should be sympathetic co-operation between the manufacturing department who supervise the cleaning and issue the certificate, and the engineering department who carry out the repair work, and unless this spirit is carried right down to the workers, it will be impossible to get efficiency in the cleaning of vessels from the point of view of safety and economy. Everything should be done to make the routine for the issue of certificates as simple and as definite as possible. This is the reason why, under certain circumstances, the lower ranks, such as foremen and charge hands, are authorised to certify certain vessels.

Re-inspection and Re-certification if Conditions Alter

The book containing the certificates of safety gives on the inside cover the actual working of the Chemical Works Regulations on this point, and also states the procedure if the vessel cannot be certified and helmet and lifeline have to be used. The note at the bottom of the certificate which covers the point about re-certification is as follows

This certificate is issued for a plant or closed vessel only as it now stands; if any sludge is disturbed or any abnormal condition arises, men must be at once withdrawn from the plant or closed vessel and it must be reported at once to the shed foreman or charge hand, who must consult the proper authority. A further inspection will then take place, and if necessary, a new certificate will be issued.

The first edition of certificates did not have this note, and we struck several cases of trouble owing to abnormal conditions arising, especially when dealing with vessels which have a loose lining, for instance, a lead lining. If there is a crack a loose lining, for instance, a lead lining. If there is a crack in a lead lining which has to be repaired by a plumber, it is very difficult to ensure that when the lead is cut dangerous liquid will not flow into the vessel, and this is the sort of thing which demands the withdrawal of men and re-inspection.

Instructions for Cleaning Preparatory to Inspection

In order to show the type of instructions which have been drawn up for cleaning vessels, the following is put forward as

Plant X. Instructions for cleaning vessel ZY before it is

 entered for repair or other purpose.
 (1) The vessel is to be disconnected entirely at all points; all external connections to be removed in such a way as to give the maximum ventilation to the vessel. (a) The vessel to be completely filled with cold water, agitated for an adequate time either by agitator, if one is provided, or by a temporary compressed air connection well immersed in the water; the liquid is then run off. This operation should be repeated three times. (b) The vessel should then be completely filled with water and boiled two hours by open steam with agitation. (c) The vessel should then be cooled down by admission of cold water or by standing for a sufficient time, e.g., over night.

(2) A mouse should then be put into the vessel, and if, after remaining at least a quarter of an hour and preferably half an hour it appears normal, the certificate can be given. At the discretion of the individual signing the certificate the mouse may remain in during the whole time the man occupies the vessel. In case of doubt no man is allowed to enter without a safety helmet.

(3) At the time of issuing the certificate, point out to the recipient that the condition of the vessel as it stands only is certified; if, therefore, any man entering the vessel has to disturb sludge, cut a lead lining, etc., etc., and so set up a fresh set of conditions, it will be necessary probably to clean the vessel out again and cancel the first certificate.

The co-operation of other departments concerned, e.g., Engineering Department, must be sought, and an immediate report demanded (for his own safety) by the man entering, if he has the least doubt of the safe condition of the yessel as regards time, etc.

the vessel as regards fume, etc.

In such a case the certificate must be cancelled and the man or men working in the vessel must be told to come out, and the process of cleaning and testing the vessel under (a) and (2) must be repeated.

(4) When the vessel to be entered is of the character described under paragraph 3 the man must be allowed to enter in the daytime only (9 a.m. to 5 p.m.), when the assistant in charge of the plant is actually on the spot.

Experience with Mice

Mice were first used for testing the atmosphere of vessels at Dalton Works, in December, 1927, and at first the introduction of this test into works controlled by fully qualified chemists was received, perhaps, somewhat sceptically. It was soon found, however, that there at least was a practical test, and now the chief advocates of the use of this test are the qualified staff.

The number of mice put into vessels per month average 80, and the breeding and care of the mice is part of the duties of the works fireman. The number of mice which die on active service does not average more than one per month, and experience has shown that this test is both practical and reliable.

There is one thing which we have found out which rather suggests that the procedure outlined in Mr. Pratt's paper under the heading "Certification that the vessel is safe to enter," sub-heading "Gassing risk," which states that the mice should thereafter remain in the vessel so long as the men are there, and the condition of the mice should be observed at frequent intervals, is not in all cases practical, as we have found that if there is any hammering or scraping going on the mice become excited, and it is impossible to tell from the behaviour of the mice whether they are being affected by fume or excitement due to the noise. We prefer, therefore, not to keep the mice in the tank the whole of the time the men are in, but to have them lowered at stated intervals.

Use of Safety Helmet and Lifeline

The only cases where it is the general practice to use a safety helmet and lifeline when cleaning out vessels are those when the vessels have no bottom outlet and are liable to contain sludge, e.g., crude benzol tank wagons.

We make it a practice to clean out vessels for safety entry rather than have men working in safety helmets, as we find that repairs cost much more under these conditions and generally men do not like wearing them. This brings up the important point that the design of safety appliances such as helmets, breathing apparatus, goggles, etc., has not been, in my opinion, sufficiently developed in detail with regard to the comfort of the wearer. Many types of safety gear are excellent from the point of view of safety, but they hamper a man in his movements and often are uncomfortable to wear. I suggest that great improvements can be made in the design of such gear. From the point of view of the user all such apparatus should be of extremely light weight, comfortable, and should allow for a clear vision. There should be also no hampering of movement. I feel sure that a lot of the reluctance to use safety appliances and the tendency at times for a man to take a chance and enter a vessel or area without taking

proper precautions is due to a wish to avoid personal discomfort entailed in the wearing of safety gear. I am sure that this aspect of the problem would amply replay full investigation.

Design of Plant

A final point which is very much to the front in the dyestuffs industry is the detailed design of the plant with a view to easy and quick cleaning and repair. This is not always possible, as often a plant is designed to be used for a definite operation, and so far as the engineer designing the plant is concerned, the provision he has made is adequate. Everyone on the manufacturing side knows however, that chemical processes change, and parts or the whole of a plant are liable to be switched over to deal with a process for which it was not designed, but to which it is readily adaptable. In such cases the provision made for easy cleaning and safe repair may be quite inadequate under the new conditions. I suggest that with general chemical plant, for whatever purpose, due regard should be given in its design to the provision of adequate means for entering, ventilating and cleaning. This may mean a slightly higher first cost, but if the vessel is to form part of a plant which will be subject to frequent cleaning and a high maintenance cost due to the peculiar nature of the pro-cess, this extra first cost will soon be saved in reduced cost of repairs and in something which cannot be valued in £ s. d.viz., greater safety for the workers.

Finally, as far as the dyestuffs industry is concerned, the question of the safety of the workers while cleaning and repairing vessels has to be considered as soon as a plant is in its very early stages and is being discussed by the chemist and engineer. In modern industry, with the use of all kinds of chemicals from corrosive mineral acids to chlorine and phosgene, it is essential that plant shall be designed with due regard to all hazards. I am of the opinion that safety measures should be considered with the design of the plant or even earlier, with the layout of the process, and the more thought given at this stage, the easier will it be to apply safety measures when the plant is in operation.

Scottish Market Conditions

Conditions in Scotland during the last month have remained much the same as previously. The Scottish dyers' dispute between the Amalgamated Society of Bleachers and Dyers and the Scottish Employers' Federation of Bleachers and Dyers (Piece Goods section) was settled early in the month, specific reductions being agreed upon.

The Civic Week held in Glasgow was not very well favoured in the matter of weather, but was otherwise a success and is considered to have been of help to business both in Glasgow and the district.

The tweed trade is still working on short time, it being calculated in some cases that the working is only up to about 40 per cent. of capacity. As before, however, there is still great difference between individual manufacturers. Spring orders for the 1932 season are not coming in too well at present and as usual recently novelties are proving the most successful.

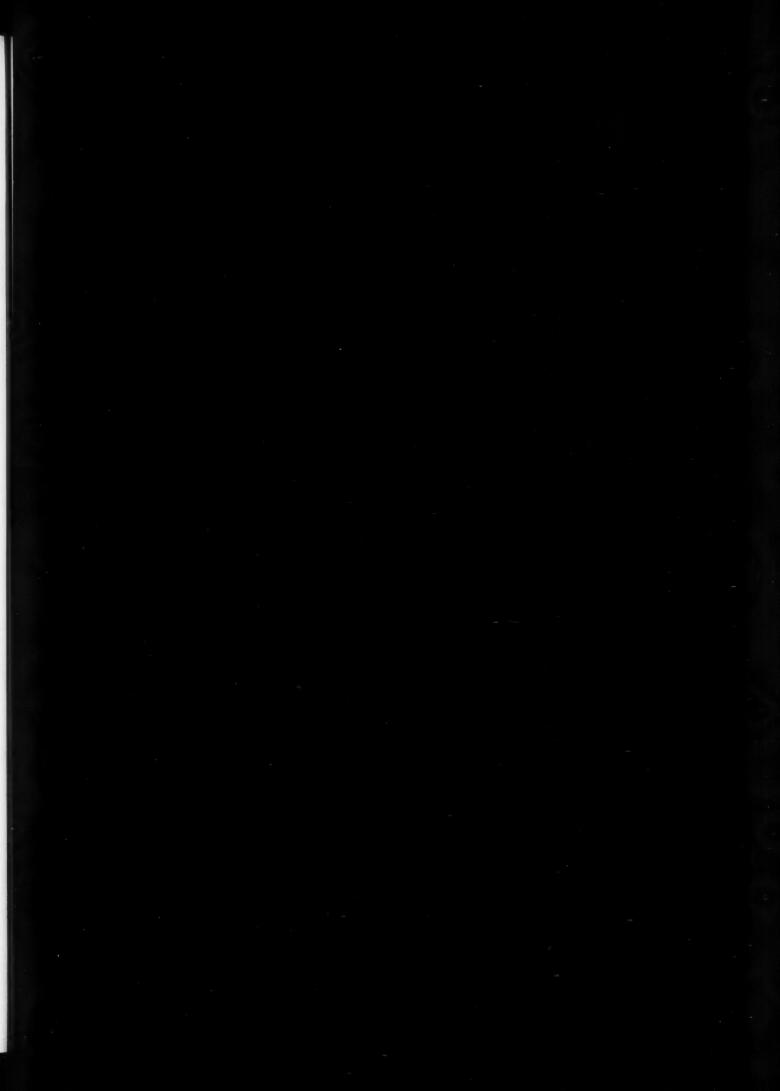
and as usual recently novelties are proving the most successful.

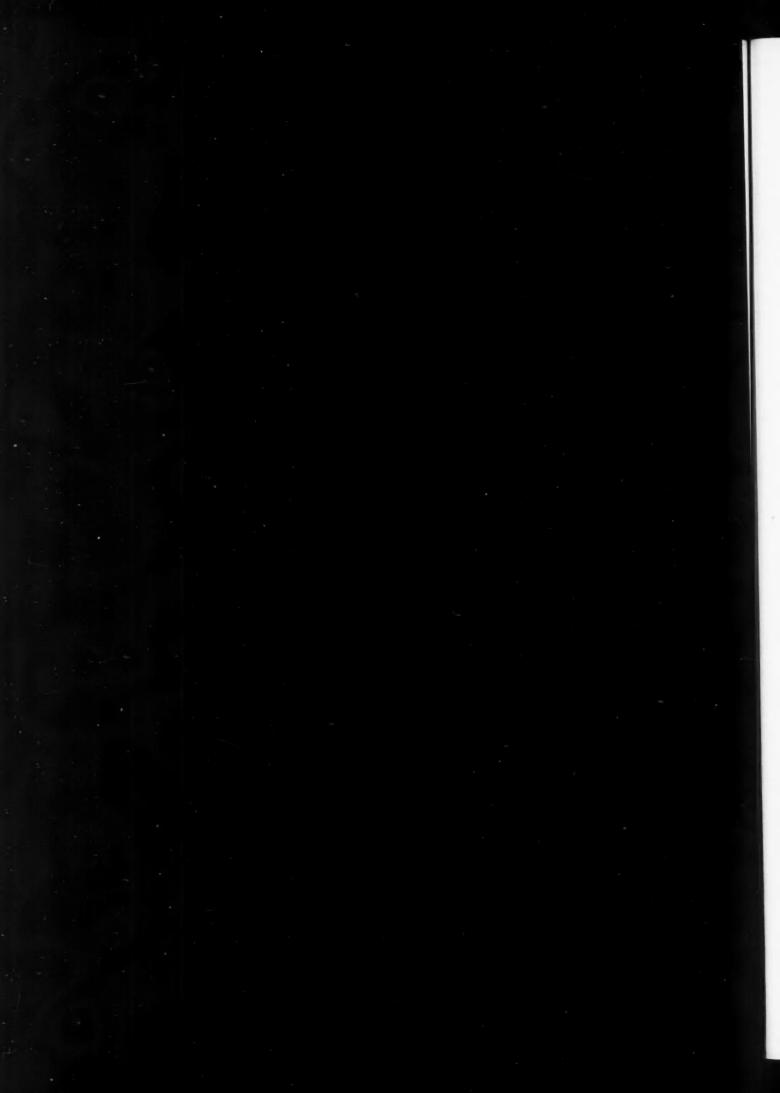
The chemical trade has remained fairly steady during the month with a slight decrease in export orders.

Delustring of Cellulose Acetate Rayon

According to a recent patent* for the permanent delustring of cellulose acetate rayon it has recently been proposed to precipitate within it a small proportion of zinc sulphide; this substance is sufficiently white to allow its employment without yellowing the rayon. It is to be noted that the delustring thus obtained is much more permanent than that produced by the older process of boiling the rayon in a solution of soap, but at the same time the rayon gains an affinity for cotton dyes. This change in dyeing properties is not due to saponification, since this does not occur, but rather to the fact that the cotton dyes form lakes with the zinc sulphide.

The method adopted consists of treating the rayon with a solution of a zinc salt (e.g., zinc chloride) and a swelling agent such as acetic acid or acetone, and then passing the rayon without previous rinsing through a solution of sodium sulphide; afterwards the rayon (delustred) is washed and soaped.





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Developments in the Production of Lead Alloys

(From a Correspondent)

Recent research on lead and its alloys is described in the following article, with special reference to the production and properties of lead-calcium and, other alloys having a high tensile strength.

LEAD is a metal which is easily reducible from its ores, and one which can be worked and wrought with great ease, and it is, therefore, readily understandable why it has been in general use for many purposes for centuries. It possesses high powers of resistance to atmospheric corrosive influences and also to attack by sulphuric acid, and it is these properties which account for the consumption of the metal in large quantities in the form of pipes and sheets in domestic, architectural and chemical plant applications.

The world's annual production of lead is in the region of 13 million tons, of which amount probably about one-quarter or less is used in the form of compounds, such as carbonates, oxides and chlorides, for the manufacture of paints and pigments. The bulk of the remainder is used to meet demands for pipe, sheet and cable sheathing, and a variety of other uses. Apart from its use as pure lead, the metal in the form of alloys is utilised for the production of bearing or antifriction metals, type metals, fusible alloys and for soft solders.

Lead in Chemical Industry

Lead pipe which is produced by extrusion is used in the building and chemical trades, where it finds extensive application because of the ease with which it can be manipulated, its resistance to bursting by frost in virtue of its ductility and its resistance to corrosion. In sheet form it is used as a roof covering and for guttering, and to some extent the metal is used in the form of castings for decorative work.

In the chemical industry sheet lead of high purity is called for, and metal of 99.99 per cent. purity is now produced and used commercially. It is employed chiefly for lining plant in the sulphuric acid industry and for protection against sulphuric acid or solutions containing sulphuric acid. The metal is also used for handling cold concentrated nitric acid, cold dilute hydrochloric acid, concentrated acetic acid, phosphoric acid and acid sulphite liquors. Although it resists attack by cold concentrated sulphuric acid, it is appreciably attacked if the acid is heated, but it is resistant to hot acids of a concentration up to about 78 per cent. Chemical lead is mechanically very weak, and although it can be strengthened by the addition of such elements as antimony the resistance to corrosion is impaired. The plant may be lined in the ordinary way with lead sheet. Most of the failures of lead linings are due to continuous mechanical strains, and the best form of linings are those known as homogeneous lead linings, which consist of lead sheet about \(\frac{1}{8} \) in. to \(\frac{1}{4} \) in. thick, welded on to the walls of the vessel. To be successful the welding must be carefully and skilfully carried out, there being no solder or other materials between the lead and metal being lined. The advantages of homogeneous over loose lead linings are the improved heat transference following the close contact of the lining with the vessel itself and absence of intervening air layer, elimination of troubles due to differences in linear expansion between the lead lining and the basis metal, and the general strengthening effect imparted to the lining by its being closely attached to the vessel instead of being

Lead-Alkali Alloys

Lead-rich alloys containing antimony, or tin and antimony, have been extensively used for bearings, and in the last few years other lead-rich alloys comparable in properties with the high tin-bearing alloys have been developed. These are

essentially lead-alkali and lead-alkaline earth alloys. were developed in the United States and marketed under such names as "Frary" metal and "Ulco" metal, and in Germany as "Mathesius" metal, "Lurgi Lagermetall" and "Bahn-The straight lead-barium alloys contain 96 to 98 per metal." cent. of lead and 2 to 4 per cent. barium, while others contain up to about 1 per cent. of calcium. Bahnmetal, which is extensively used as lining metal on the German railways, contains about 0.75 per cent. calcium, 0.5 per cent. sodium, and 0.05 per cent. lithium, and has a compressive strength of about 12 tons per square inch, and a Brinell hardness of about Some of these alloys possess the property of ageing at room temperatures, with a resulting increase in strength and hardness. Although they have excellent bearing properties they require special methods of manufacture, because of the readiness with which the special constituent alloying elements Usually they are prepared by electrolysis of a mixture of fused alkali and alkaline-earth salts over molten lead which acts as the cathode. There is a loss of alloying element on re-melting, but the drossing which takes place has been overcome to some extent by the addition of small amounts of other metals.

For Cable Sheathing

Lead is used widely, chiefly as lead-rich alloys, for cable sheathing, a large percentage of the total output of the metal finding this important application where its function is to afford chemical and mechanical protection to the inner insulators and conductors. Some interesting information regarding the application of lead alloys as materials for cable sheathing is given by R. S. Dean and J. E. Ryjord in *Metals* and *Alloys*, March, 1930. To be satisfactory, the alloy must be capable of being formed into sheathing at a temperature so low that the insulating material, which is usually paper, will not be damaged. It must also be pliable, to permit of easy reeling and unreeling, and resistant to corrosion and failure from fatigue and tensile stresses. Originally lead was used, but this was replaced by an alloy of lead containing I to 3 per cent of tin, which was both stronger and more resistant to corrosion. This alloy, in turn, was replaced by a cheaper alloy of lead containing I per cent. antimony. The presence of small amounts of certain elements in solid solution in lead prevents the breakdown of the material from intercrystalline corrosion, and the chief matter for consideration in the use of these materials as sheathing is their mechanical properties, since failure by corrosion alone is not common. Practical experience in installation and service conditions indicates that the optimum value for tensile strength is about 4,000 lb. per square inch with the maximum possible fatigue limit.

The I per cent. antimony-lead alloy is a solid solution at 250° C., the temperature at which it is extruded, but at ordinary temperature this breaks down, resulting in small particles of antimony being dispersed throughout the lead. In this condition the alloy is both harder and stronger than it is either as a solution or coarser aggregate. The ageing of the extruded alloy takes place at room temperature and while the strength increases to quite a marked extent, it subsequently gradually decreases. The fact that cold working accelerates the agglomeration of antimony particles limits the improvement which can be effected in this alloy since all cable is subjected to some stress.

cable is subjected to some stress.

Lead-Calcium Alloys

While some very interesting and useful work has been carried out in connection with the effect of other elements such as arsenic and cadmium on the stabilisation of leadantimony alloys, the most notable advance has been made with straight lead-calcium alloys. As in the case of the leadantimony alloys, the useful alloys of the lead-calcium system are those confined to the lead end (up to o·I per cent. calcium) and which possess age-hardening properties. Structurally they are composed of a solid solution of lead and calcium or lead with the compound Pb3Ca dispersed through it, depending on the treatment. The solid solution of the lead-calcium alloys obtained by quenching breaks down much more slowly than the corresponding lead-antimony solid solution, particles of antimony separating and growing to the size of microscopic visibility in a very short time, whereas particles of Pb₃Ca cannot be detected microscopically after the alloy has been held at 150° C. for a week. In addition, particles of Pb3Ca do not agglomerate so readily as particles of antimony in lead on cold working. In some very vital aspects, therefore, the lead-calcium alloys are superior to the lead-antimony alloys for cable sheathing.

The alloys are prepared by adding a 1 per cent. calcium-lead alloy to molten lead which is covered with charcoal, the alloying being readily effected at about 370° C. The 1 per cent. calcium alloy is made by the electrolysis of fused calcium chloride with a carbon anode and molten lead as a cathode. Within the limits of temperature suitable for extrusion, that is about 200 to 275° C., higher temperatures are more desirable in that the final tensile strength is reached more quickly on ageing

Tensile Strength

The tensile strength of the alloys after ageing varies from 2,000 to 7,000 pounds per square inch according to the amount of calcium present and the temperature at which ageing has been carried out. To obtain the maximum hardening effect on quenching the quenching temperature increases with the calcium content. The alloy containing 0.03-0.04 per cent. calcium has the widest range of extrusion temperatures, cooling from which will give a tensile strength approximating to 4,000 pounds per square inch. This alloy seems to be the most satisfactory one for sheathing, for it is superior to those containing greater quantities of calcium which flow appreciably under low stresses. The dynamic fatigue limit of the alloy as determined on a Moore machine for flat specimens working at 1,700 reversals per minute is 1,200 to 1,500 pounds per square inch, while that of the 1 per cent. antimony-lead alloy is of the order of 900 to 1,000 pounds. Tests in which the length of time required to break the alloy under loads of a value less than the tensile strength indicated that the calcium lead alloy with a given load would last from 10 to 100 times as long as the antimony-lead alloy.

as long as the antimony-lead alloy.

E. E. Schumacher and G. M. Bouton (Metals and Alloys, March, 1930) have established by careful thermal, microscopic, electrical conductivity and hardness methods the solubility limits of calcium in lead at various temperatures. Only those alloys between pure lead and the compound Pb₃Ca are of industrial interest and while alloys up to 2 per cent. calcium have been used as bearing metals the useful limit in application to cable sheathing is about o-1 per cent. calcium.

The solubility of calcium in lead has been found to increase from 0.01 per cent. at 25° C. to 0.1 per cent. at 328.3° C. The increase in solubility is very small at low temperatures and is only about 0.015 per cent. at 200° C., after which it increases more rapidly. At 265 and 280° C. the solubilities are 0.04 and 0.05 respectively. In cooling curves of all the alloys containing more than 0.07 per cent. calcium an arrest at 328.3° C. was found indicating a peritectic reaction in this portion of the system.

Tensile tests on alloys with different calcium contents showed that in the quenched condition the tensile strength rose from less than 2,000 pounds per square inch with lead containing no calcium to more than 5,000 pounds with about 0.20 per cent. calcium, after which it decreased, the value for the alloy with 0.26 per cent. calcium being about 4,000 pounds. In alloys which had been aged for 18 months at room temperature the maximum value for tensile strength which was more than 7,000 pounds occurred at about 0.08 per cent. calcium. The finding that the calcium-lead alloys have

higher tensile strengths and greater resistance to fatigue than the 1 per cent. antimony-lead is in agreement with the result obtained by Dean and Ryjord.

Other Alloys

Other alloys possessing much greater resistance to intercrystalline cracking and fatigue than pure lead have recently been developed in this country and have been described by Nightingale. The alloying elements are cadmium and tin which together do not exceed in amount 1.75 per cent. The alloys are particularly well suited for uses where their increased mechanical properties are of value, for it is possible on this account to effect considerable savings in weight. Their tensile strength is of the order of 1.6 tons per square inch, elongation 52–55 per cent. and fatigue limit up to 0.74 tons per square inch, the corresponding values for pure lead being about 0.9 tons per square inch, 80 per cent., and 0.18 tons per square inch.

The British Steel Industry Mr. W. Benton Jones's Review

An important analysis of the present-day position of the steel industry was given by Mr. W. Benton Jones (chairman) in his address at the annual meeting of Steel Industries of Great Britain, Ltd., held in London on Monday. The following production figures, he said, reported an aspect of the steel industry that was often overlooked, and illustrated the fact that it was a growing industry, and, old as it seemed, it might be that it was yet in its infancy:—

In 1913 the production of steel was:—In Great Britain,

In 1913 the production of steel was:—In Great Britain, 7,660,000 tons; in Western Europe, 25,670,000 tons; in the world, 75,150,000 tons.

In 1925 production was:—In Great Britain, 7,390,000 tons; in Western Europe, 25,440,000 tons; in the world, 88,930,000 tons.

In 1929 production was:—In Great Britain, 9,640,000 tons; in Western Europe, 34,990,000 tons; in the world, 118,300,000 tons

The steel industry of this country was affected, like all other industries, by the world-wide trade depression, but it is also suffering from something more, it is handicapped in relation to other steel-producing countries. Since the war the steel industries in those countries had been aided by collapse of currencies, which had in effect cancelled prior charges, by the rebuilding at little cost to the industries themselves of plant destroyed during the war, and by the building of new plants and the rebuilding of old plant with the help of loans advanced by private individuals in other countries. In addition, these plants were operated by labour for the most part living at a lower standard than British labour, and the markets for their products in their own country were protected by tariffs. Under these circumstances, the steel industries in Western Europe were able to undersell British steel in their export markets, and their export markets, it should be noted, included the home market of Great Britain.

It was surprising to find how well the British steel industry had stood up against these handicaps. From the figures already quoted, it would be seen that the steel production of both Great Britain and of Western Europe were practically the same in 1925 as in 1913, that is to say, in 1925 the British steel industry maintained its position both absolutely and relatively as compared with Western Europe. Again in 1929, a year in which Western Europe was able to take full advantage of the handicaps in its favour, production of British steel not only reached its highest figure, but the relation of its production to that of itself and Western Europe added together, which in 1913 was 23 per cent., in 1929 was only reduced to 21-6 per cent.

He did not wish to imply that this situation could be regarded with complacency, and its stubborn fight had left the British steel industry with no profits and therefore with insufficient funds to equip itself to carry on the struggle. It was clear that the contest could not be carried on indefinitely against these handicaps, and it was logical to conclude that assistance should be given to the British steel industry in the direction in which its competitors had been assisted. Actually the British steel industry only asked to have its home markets protected, and was willing then to do its best to continue the struggle, relying on re-establishing itself out of profits with the aid of such new capital as the public would be willing to invest.

Metallurgical Topics: Monthly Notes and Comments From Our Own Correspondents

Marketing Technical Products

Some aspects of technical publicity of special interest to many metallurgical firms were stressed by Mr. F. Rowlinson, of the United Steel Companies, Ltd., in a recent address to the Bradford Publicity Club. The technical buyer, he said, knew what he wanted frequently better than the manufacturer he was buying from, and he tied up his requirements in every kind of watertight specification. There was, of course, scope to interest him either in newer or less expensive or more standardised products, or to show him that needs which he had considered special and peculiar to his industry could best be met in a different way. But he would not be gulled by high-sounding meaningless copy or by campaigns appealing to his emotions.

In speaking of the publicity department in relation to the selling section of the business, he made it clear that publicity was an integral part of the whole marketing policy of the firm—but too often the firm had no marketing policy. Technical publicity also concerned itself in disseminating confidential information to salesmen about new or existing products, and could frequently learn much from investigation of complaints. It became a vital importance in combating not only the ordinary form of competition (that of manufacturer against manufacturer), but in newer kinds of competition—industry against industry—and (a form which was particularly rife) entrepreneur against basic manufacturer.

Tantalum and Niobium

The tantalum electric filament electric light bulb, which succeeded the carbon filament lamp and was succeeded in turn by the tungsten filament lamp, was the only use made of tantalum for some time. Since the war period, however, considerable development has taken place, and it has become a serious rival to platinum for many chemical and physical purposes owing to its highly resistant properties. In the United States extensive uses for the metal have already been developed, especially in the radio industry, and recently, for example, it has been employed for spinnerets in the artificial silk industry.

A summary of our present knowledge of tantalum, as well as of its sister metal niobium, which has only commercially come into notice lately, is given in the monograph of the Imperial Institute, "Tantalum and Niobium," which will shortly be published by H.M. Stationery Office. In this monograph, which deals with both tantalum and niobium, but naturally mainly with tantalum on account of the greater amount of information available about it, a general account is given of the metals themselves as well as of their ores, and the production, properties and uses of tantalum. The greater part of the book is devoted to descriptions of the more important occurrences of tantalum and niobium minerals, both British and foreign, from which it is to be noted that Western Australia and North Australia are at present almost the only suppliers of tantalum ore in the world.

Zinc Ores

Another monograph in the series of the Imperial Institute, which is also to be published shortly by H.M. Stationery Office, gives a full general account of the zinc industry. Some idea of the magnitude and importance of the metal zinc is obtained when it is realised that over 1,400,000 tons are produced per annum; that nearly forty countries are mining zinc ores, and that over twenty are smelting or converting them into metal or a large number of other zinc products. Outside its familiar uses for making brasses and other alloys, for galvanising iron, in the form of sheetings or castings used in architectural work, and in the manufacture of lithopone, used principally in making linoleum, there are a host of other uses whose number is continually growing.

This monograph may be regarded as a revised edition of a former monograph of the Imperial Institute and of a similar production of the Imperial Mineral Resources Bureau, which was incorporated with the Mineral Resources Department of the Imperial Institute. In the introductory chapter is a concise account of the nature and occurrence of zinc ores and their

marketing; the world's production of zinc and of its ores; the metallurgy of zinc and the production of its compounds and of the recent developments that have taken place in the zinc industry. A large amount of statistical information is given here as well as elsewhere in the book. The major portion of the publication is devoted to the world's resources of zinc ores, divided into British and foreign, in which the principal deposits of the different countries are described, and from it will be realised the great reserves of ore that exist in the British Empire. A very full bibliography completes both volumes.

Recovery of Secondary Metals

Mainly owing to the higher yearly average price of copper and the greater recovery of other metal, the value of secondary metals-that is metal recovered from scrap or waste-showed a large increase in 1929 over the figures for the preceding year. The figures for the United States, issued by the Bureau of Mines, show large increases in the production of secondary copper and brass, lesser increases in lead and aluminium, while the recoveries of secondary zinc, tin, antimony, and nickel showed small decreases. The amount of secondary copper produced as metal was 297,000 short tons, while 208,950 short tons of the metal was contained in secondary brass and 120,000 tons in other alloys, making a total recovery of 625,950 tons of copper. As regards lead, 138,500 tons was recovered from the smelters and 172,500 tons contained in remelted alloys, the total of 311,000 tons being equal to approximately 35 per cent. of the total lead production of the United States. The statistics for zinc show that in addition to 65,400 tons of secondary spelter and 65,670 tons recovered in brass, 7,424 tons was obtained as zinc dust from dross and 12,871 tons was contained in lithopone made from zinc skimmings and ashes, while no less than 8,437 tons of zinc was contained in the zinc chloride made from similar sources. Details given for tin show that 221,643 long tons of clean tin-plate scrap was treated at detinning plants and 855 short tons of metallic tin recovered, in addition to 3,545 tons in the form of oxide and chlorides.

Uses for Rare Metals

Gallium, germanium, indium, and scandium are four very rare metals for which very few uses have as yet been found, but they possess certain interesting qualities that point to a commercial use at some not distant time. Nowhere found in sufficient quantities to attract attention, these little-known elements are nevertheless widely distributed in the earth's crust. So far they are found commercially mostly in the sulphide ores of zinc and must be considered as being largely curiosities of the zinc smelter. Recent progress in electrolytic zinc refining, however, now gives promise that they may be open for the recovery of these very rare metals in larger quantities.

Experiments conducted about five years ago indicated that gallium was well adapted for use in thermometers for recording temperatures above 700° C. Other suggested uses for gallium are for the production of optical mirrors, and as an alloy with aluminium to produce cathode material for metal vapour lamps. A number of uses have been suggested for germanium, but as yet no outstanding advantages have been demonstrated which would seem to render it better suited to these uses than other more abundant materials.

other more abundant materials.

Aluminium alloys containing germanium have been prepared and tested, it being found that the addition of small quantities of germanium to duralumin, "lautal" and "aludur" alloys increased their strength by I kilogram per square millimetre and improved the rolling properties of duralumin. Aluminium-magnesium alloys containing up to 5 per cent. of germanium have been patented in Germany. The use of germanium in steel, including rustless steel, has been suggested.

No commercial use of indium has been developed, but its low melting point and high boiling point suggest that it, like gallium, may be suitable for use in thermometers for recording very high temperatures. The use of indium in bearing metal alloys in quantities ranging from 0.5 to 3.5 per cent. has been patented. Further details are given of "Gallium, Germanium, Indium and Scandium," Information Circular 6,401, of the United States Bureau of Mines, Department of Commerce.

Welded Containers for Compressed Gases

Construction, Materials and Recommended Tests

A Report giving recommendations for the material, methods of construction and testing of welded containers for the storage and transport of chlorine, sulphur dioxide, phosgene and ammonia, has been prepared by the Committee on Welded Containers, and is issued by the Department of Scientific and Industrial Research (H.M. Stationery Office, 1s. 3d. net). It may be considered as supplementary to the Fourth Report of the Gas Cylinders Research Committee on the conveyance of liquefied gas in solid drawn cylinders.

It is unquestionable, the present Report states, that the solid-drawn cylinders provide a more reliable type of construction for the conveyance of compressed gases. The introduction of a welded seam inevitably introduces an element of uncertainty, since it is never possible, short of destroying the vessel, to establish beyond possibility of doubt the soundness of each individual weld throughout its length. Nevertheless, the use of lap-welded vessels was at one time recognised even for the transport of gases at such high internal pressures as 1,800 lb./sq. in.; in the Report of the 1895 Home Office Committee, lap-welded steel or wrought-iron cylinders, as well as seamless steel cylinders, were recommended for the transport of oxygen and other gases. The working internal pressures in cylinders containing chlorine, phosgene and ammonia are considerably lower than in cylinders containing "permanent" gases. Moreover, the use of welded pressure vessels is extending very considerably in modern engineering practice.

Difficulties with Large Drawn ubes

The adoption of welded vessels for the purpose in question is rendered desirable by the fact that the operation of drawing steel tubes becomes difficult and relatively costly when the diameter exceeds a certain amount. There is further the constructional difficulty of closing tubes of large diameter. The capacity of solid-drawn cylinders is therefore limited. Their limited size involves greatly increased charges in handling large quantities of the liquefied gas with the result that, during the war, the larger vessels which form the subject of this Report were introduced for the conveyance of liquid chlorine.

Where containers have to be used having a larger capacity than can economically be made from solid-drawn tubes, they should be made of carbon steel having the following percentage composition: Carbon, o 10 to 0 20; sulphur, o 04 maximum; phosphorus, o 05 maximum; manganese, o 40 to 0 60; silicon, o 20 maximum, the balance being iron.

The steel used for making the containers should be produced by the acid or basic open-hearth process. Blooms and billets for the manufacture of the containers should be supplied with a guarantee from the steel maker that the ingots from which they have been produced have been made by one of the above processes. Facilities for the inspection of the steel at a steelmaker's works should, if so desired, be afforded to the representative of the container manufacturer. Facilities should be afforded by a system of marking and registration of billets to enable the material from which the containers are made to be identified.

Tests and Welding Conditions

Tensile and bend tests should be carried out on the material in the manner described in British Engineering Standards Associations Report No. 24, Part 6, Specification No. 18, and should give the following results: (a) Tensile strength 24 to 28 tons/sq. in. (b) Elongation not less than 27 per cent. on an 8-in. gauge length. (c) In the cold bend test the test piece should withstand, without fracture, being doubled over until the internal radius is not greater than the thickness of the test piece and the sides are parallel.

test piece and the sides are parallel.

The conditions under which the welding operations are carried out should conform to the following requirements:

(a) The material should not be heated to a temperature in excess of that required to obtain a satisfactory joint. (b) No extraneous material should be added to the joint. (c) Sufficient work should be put into the material while hot to make an effective weld, but forging should not be continued after the material has cooled below about 800° C. (d) That

the overlap, when the edges are brought together for the welds, is of an amount, depending on the thickness of the plates, adequate to provide an effective joint. In the case of drums, it should also be seen that the circumferential flange on the concave end plates fits smoothly into the cylindrical body, and is of an extent sufficient to ensure a weld of adequate depth; and that, after welding, while the material is still hot, the flange is given a slight inward crimp. The welds should, be carefully examined after completion, the examination being made internally as well as externally wherever possible.

Thickness of Wals and Cap

A table is given for determining the thickness of the wall of the containers, and it is urged that in no case should the thickness be less than o 375 in. The thickness of the dished end plate or cap should be at least 30 per cent. greater than the thickness of the body plate of the container. The radius of the spherical portion of the dished end plate should be not greater than the diameter of the cylindrical body of the container, while the radius of the end plate in the bend at the flange should be not less than four times the thickness of the end plate and not less, in any case, than 2.5 in.

In the case of the drums, the valve should be set in one of the recessed ends and should be protected, when the drum is not in use, by a stout metal cap or metal cover, securely attached to the body of the drum, the design being such that the cap or cover is nowhere in close proximity to any part of the valve or valve body.

After manufacture the containers should be submitted to the following heat treatment: The containers should be heated in a furnace to about 950° C., and remain there for no longer than the time necessary to enable the whole of the material to attain that temperature. They should then be withdrawn and allowed to cool in air away from draughts.

Each completed container should be submitted to a hydraulic test. The proof pressure to be applied should be calculated from the formula

$$p=2 \frac{q't}{D-t}$$

where p = proof pressure; lb./sq. in.; q' = 15,680 lb./sq. in.; D = outside diameter of container; in.; t = thickness of body plate; in. The container should show no sign of leak under the test

As a drop test (for drums only): One drum in every batch, or one in at least every 100 should be submitted to an additional test. The drum should be filled with water to 95 per cent. by volume of its total capacity, the remaining space being charged with air to a pressure equal to the working pressure for which the drum is designed. The following tests should then be carried out: (a) the drum should be raised in a horizontal position with the longitudinal weld undermost, to a height of 6 ft. measured from its lowest point, and dropped on to a transverse rail placed on a solid concrete or similar floor; (b) the drum, inclined at an angle of 30° to the horizontal, should again be raised to a height of 6 ft. measured from its lowest point and dropped on a concrete or similar base. No sign of leakage should occur as the result of these tests. If the drum should fail under the tests two more from the batch or two more from at least every 100 should be subjected to the same tests and if either of these fails the batch should be rejected.

Statistics of Iron and Steel Industries

A NEW edition of Statistics of the Iron and Steel Industries has just been published. It comprises 191 pages and gives in considerable detail information regarding output, material consumed, imports and exports, etc., for 1929, and historical statistics with regard to production, foreign trade, etc., for the chief iron and steel-producing countries. The section giving the import tariff duties on iron and steel products for the more important countries has now been considerably extended and it is the only volume published which gives this information. To the United Kingdom figures a new table has been added showing the numbers insured in the industry and the percentage unemployed at various times. The volume may be obtained from the office of the National Federation of Iron and Steel Manufacturers, Caxton House, Tothill Street, Westminster, 5s. 5d., post free.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

We have now come to the end of the year 1930, and probably the only satisfaction that can be derived from that statement is that we have passed through so much of the depression from which the iron and steel trade has been suffering, and we are so much nearer the revival. It is not yet in sight. We have in the past been accustomed to expect renewed activity in trade at the commencement of the year, but this time the hope is a rather forlorn one. The favourable influences which are necessary to set in motion a trade revival are not in evidence.

Long Christmas Stoppage.

The markets still lack confidence, and we start the New Year on a low level which, as far as one can see at present, seems likely to continue for some time. It is significant that throughout the industry the Christmas stoppage has been extended to two weeks, and the sole reason is the lack of orders. It would have been useless to look for any material volume of business being transacted during the week after Christmas, and to start up the works for that week would have meant the clearing up of the order book, leaving practically nothing on which to start for the following week. It was better policy therefore to make a longer stoppage so that the orders which might come in during the holidays would enable something like a reasonable start to be made. And there is not much cheer to be obtained from that! For the week or too prior to the holidays there had been a noticeable decline in the weight of orders received by the works, so much so that in most cases there was only a very small unexecuted balance left when the works closed down. Consequently the starting up will be none too propitious, and unless there is a decided revival in buying, which is not yet likely, the mills will be back again to short time working before the month of January is out. In some instances the works' stoppage is being extended to three weeks, and others who have so far decided on only two weeks may be compelled to remain closed for three if sufficient orders do not come in. It is a dismal note on which to welcome the New Year, but it is the truth we have to face.

Shortage of Business

Even the busiest steel works are not working at more than two-thirds capacity, while in many cases, particularly on the North East Coast, the proportion is nearer one-third not a question of price or competition; the consuming industries for the most part are equally short of work and simply have not the business to place. The remarks made by one have not the business to place. large steel maker when discussing the present position indicate the gravity of it. He said that, speaking from a purely selfish point of view, it would not have displeased him if there had been another coal strike on December 1, as the present parttime working would then have given way to a complete stoppage, and there would have been an opportunity for a useful amount of business to accumulate, so that one might again have the pleasure of working at something like full output, even if only for a short time. The monthly production figures again show the doleful state of affairs. November figures are the smallest of any month since 1921, excluding of course the coal strike period in 1926, and the December figures will naturally be less on account of the holidays. Next month we shall have the official figures for the whole of the year, and it will be interesting, although not inspiring, when it is seen how badly they compare with those of the previous year. That was a record high year in the history of the industry, while it is probable that 1930 will rank with 1921 as the lowest for a very long period, going back many years before

No Forward Buying Policy

Where shall we look for a lifting of the clouds? In some quarters we are told that as prices have surely reached the bottom limit there is bound to be very soon a buying movement which will set the industry going again. Yet for some time past, although prices have been at such a low level, there has been no tendency to buy forward, in fact it is considered

by many to be foolish to make forward contracts. Buying from hand to mouth is now the settled policy in large sections of the markets, and evidently there is no expectation that these bottom prices are likely to be advanced just yet. So that source of comfort is not very real! Another source is said to be the probability of an early change in the Government, which may result in a Conservative Government being formed, to be followed immediately by some form of protection. But that is based on too many ifs. Even supposing that a Conservative Government is elected in the near future, how are they going to proceed in the matter of safeguarding the steel industry?

There has been so much said about rationalisation being the necessary preliminary to safeguarding that some attempt may be made to insist upon the one in return for the other. That involves Government interference in the industry, which is certainly the last thing in the world that the steel makers want. In view of the experience with the coal mines, any Government may well be chary of taking a further similar burden on their shoulders. The position is by no means clear, and without trusting to what may happen in the political world, the steel makers had better continue to carry on as best they can, until either disaster or good fortune overtakes them.

Demands of the Motor Industry

It is interesting to read that there are prospects of improved conditions in the motor industry in 1931. Sir Herbert Austin gives good reasons for a more hopeful outlook, among them being the retention of the McKenna duties, the experience gained in the design and manufacture of small, economically operated cars, and the preferences given by the Dominions and Colonies. Activity in this branch of industry is always welcome news to the steel makers, as it means more orders, particularly for thin plates and small bars and the special qualities of steel. We may hope that this activity will grow towards a return of the conditions which prevailed during 1029.

In the middle of January the much talked of meeting of the joint steel associations will be held, and we shall then know whether there is to be any change in the prices of steel plates, sections and joists. Until then it is hardly likely that there will be much business placed. Some of the railway companies have deferred sending out their yearly tender forms until the meeting has been held, in order to get the benefit of any reduction that may be made. It would be a pity to reduce steel prices now that the depression has lasted so long, but no doubt the matter will be thoroughly discussed, and when the decision, whatever it is, is known, buyers will be more ready to come into the market.

Extension of Rebate Scheme

The rebate scheme which has been in force for over two years in the controlled steel materials is being adopted by other sections of the trade. The Central Pig Iron Producers' Association, controlling pig iron prices in the Midlands, is now offering a graded rebate to consumers who confine their purchases to British iron, the amount of the rebate varying from 6d. to 1s. per ton according to the quantity bought. The ferro-manganese makers have also adopted a similar scheme. In both cases the scheme has been taken up in order to meet competition from foreign producers.

competition from foreign producers.

There is very little to be said of particular market conditions. Prices for home products remain at about the same level as last month. Continental prices have changed very little, but there is not much business being placed abroad just now. The Continental works have been suffering from very much the same conditions as those which have obtained here, particularly in the lack of orders for finished steel.

The production report for November shows that there were four furnaces less in blast than in October. The pig iron output was 384,100 tons, compared with 415,000 tons in October. The output of steel was 433,700 tons compared with 512,500 tons in October.

Some Inventions of the Month By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in The Chemical Age.

Extraction of Copper, Nickel and Cobat

A process for extraction of the metals from ores containing copper, nickel and cobalt is described in Specification 336,584, dated July 10, 1929, by R. S. Carreras, of Barcelona, Spain. The ores are first leached with a mixture of dilute sulphuric acid and sodium chloride. The insoluble matter, if any, which may contain arsenides and sulphocyanides, is oxidised in a furnace, and again leached, the solution being added to the main bath. The copper is recovered from the solution by electrolysis in lead-lined wooden vats, using thin sheet copper cathodes, and anodes of lead or of copper rendered inactive by preliminary treatment with nitric acid, or of another metal rendered inactive by treatment in an acid solution containing a mercury compound. The electrolyte is then concentrated by evaporation, cooled to precipitate salts of the alkaline earth metals and of magnesium, further concentrated, and cooled to crystallize out cobalt sulphate. These crystals are dissolved in a solution of ammonium sulphate containing a little citric acid, and the solution is electrolysed, using cathodes of copper-chrome and anodes of graphite, inoxidisable steel or other metal rendered inactive. Nickel is similarly recovered from the remaining electrolyte, which may contain iron, after addition of ammonium sulphate, sodium sulphate and ammonium carbonate. Under some conditions the metals may be deposited as oxides.

Extracting Metals

METAL values are extracted from metalliferous materials by heating such materials in the presence of a "reagent metal to a temperature below the decomposition temperature of the sulphate of the "reagent metal," while subjecting the materials alternatively to an oxidising atmosphere—e.g., air—and to an atmosphere containing sulphur dioxide and air. A "reagent metal" is defined as a metal capable of two or more degrees of oxidation—e.g., iron, copper, nickel or manganese. When iron is used a temperature of 350-525° C. may be employed; when copper is used the upper limit of temperature is about 710° C. The reacting gases may be mixed with water vapour. The process is applicable to the extraction of gold, silver, lead, nickel, manganese, copper, cobalt, bismuth, zinc, cadmium, iron, etc., from oxidised or sulphide ores. In treating ores not amenable to sulphating, common salt may be gradually added. In an example copper concentrates, which contain silver and gold and small quantities of iron sulphide, are roasted for one hour at 350-450° C. mixed with common salt and roasted for 20 minutes at 435° C. in an atmosphere of air, sulphur dioxide and water vapour, whereupon the roasting and the gas treatment are repeated twice. The mass is then leached with a saturated solution of chlorine and afterwards with water, to produce a solution containing copper, gold, iron and zinc. Silver is recovered by leaching the pulp with ammonium carbonate solution. See Specification 336,770 (White), dated September 30, 1929, a communica-tion from Meyer Mineral Separation Co., of Pittsburg, U.S.A.

Obtaining Finely Divided Metals The heat required for the thermal decomposition of metal carbonyls in the hot free space of a heated vessel is supplied partly to the interior of the vessel, e.g., by hot gases or other substances introduced together with the carbonyl, or by an inverted flame, or by induction heating, and partly to the exterior of the vessel, e.g., by a heating jacket or by heating resistances. The contents of the vessel are subjected to a whirling motion. See Specification 336,007 (Johnson), dated July 10, 1929, a communication from I.G. Farbenindustrie Akt.-Ges. of Frankfort-on-Main, Germany.

Stainless Steel

A METHOD of casting stainless steel and like iron alloys containing large amounts of chromium or nickel is described in Specification 336,024, dated July 22, 1929, by W. E. Martin and J. A. Berlyn of Blackheath, Staffordshire. The alloys or the mixtures of metals for forming the alloys are melted in a crucible in a furnace of which the temperature is raised gradually and uniformly, especially between 900° C. and the casting temperature, which is usually between 1,800° C. and 2,400° C. The rate of heating may be such as to raise

the temperature 100-400° C. per 15 minutes. A deoxidant may be added just before casting.

Welding Copper
An electrode for use in the spot welding of copper articles contains one or more carbides of tungsten or a similar metal of high melting point. A small quantity of one or more metals of lower melting point, such as iron, nickel, or cobalt, may also be present. The welding may be effected in a stream of reducing gas such as hydrogen or nitrogen. See Specification 335,876, bearing the International Convention date, March 26, 1929, by F. Krupp Akt.-Ges., of Essen, Germany.

Raw or preliminarily roasted zinc blende which is to be sintered under forced draught is first mixed with zinc sulphate in the proportion of 3 molecules of sulphate to 2 molecules of sulphide in excess of the sulphide necessary to ensure combustion. A colloid such as gum or dextrin may also be added. The sulphate may be supplied in anhydrous or crystalline form or in solution and may be the product of a sul-phatizing roast or the product of the action of acid on roasted See Specification 335,600, bearing the International Convention date, March 9, 1929, by Soc. Anon. La Nouvelle Montagne of Engis, Belgium.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debt due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.] but such total may have been reduced.]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered November 22, £50,000 debenture, to Aktieselskabet Haugvik Smelteverk, Meloy, Norway; charged on book debts and goods and merchandise (including stocks of alu-

minium) acquired by the company subsequent to July 9, 1930, and for the time being in its hands. *£468,828. July 24, 1930.

BRITISH AND DOMINIONS FERALLOY, LTD., London, S.W.—Registered November 27, £500 secured notes, part of £15,000; general charge. *£8,800. November 21,

BLAENAVON CO., LTD., coal and iron masters.—Satisfaction registered November 18, £2,586, part of amount

registered August 24, 1911.

JOHNSON AND SONS' SMELTING WORKS, LTD.,
Brimsdown.—Satisfaction registered December 9, £10,000,

registered July 28, 1905.

UNITED STEEL COMPANIES, LTD. (old company), Sheffield.—Satisfactions registered November 22, £500,000, registered April 20, 1918, £1,000,000, registered April 27, 1918, £1,000,000, registered May 8, 1918, and all moneys, etc., registered July 23, 1924.

London Gazette, &c.

Companies Winding Up METAL AND IRON CORPORATION, LTD. W. A. J. Osborne, of Balfour House, Finsbury Pavement, E.C.2, appointed as liquidator, with a committee of inspection.

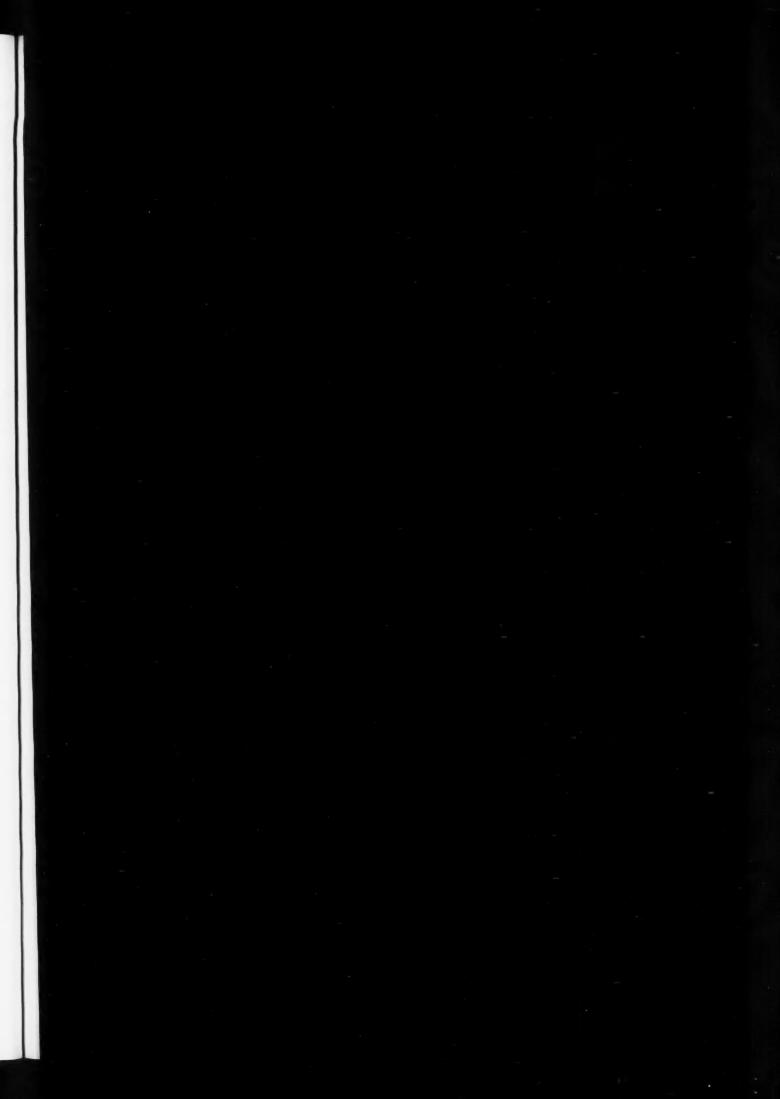
Companies Winding Up Voluntarily

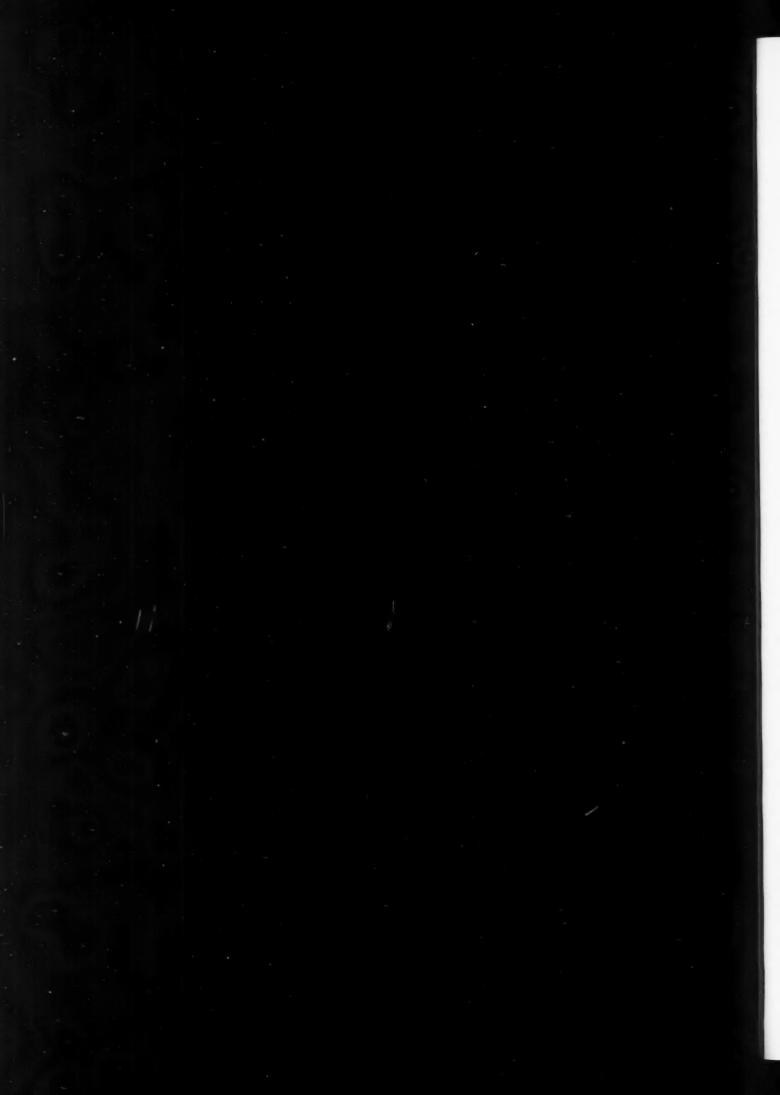
CAUCASUS COPPER CO., LTD. By reason of its liabilities, December 18. E. W. Lowe, of Dunedin House, Basinghall Avenue, London, E.C.2, Chartered Accountant, appointed as

liquidator by meeting of creditors.

DISTINGTON HEMATITE IRON CO., LTD. By special resolution passed December 9. H. P. Morrison, of 17, West-

bourne Road, Sheffield, appointed as liquidator.
WORKINGTON BLACKSTONE SLAG, LTD. By special resolution passed December 9. H. P. Morrison, of 17, Westbourne Road, Sheffield, appointed as liquidator.





Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month,

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.A. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Recent Work on Electro-Deposition

A Group of Papers

A number of papers on electro-deposition of special interest both to the technical worker in this field and the electro-plater were read at a recent joint meeting of the Electro-Platers' and Depositors' Technical Society and the Faraday Society, which was presided over by Professor J. R. Partington.

THE following papers which are summarised below were presented at the meeting:—"The Determination of the Porosity of Electro-Deposits," by D. J. Macnaughtan; "The Influence of Small Amounts of Chromic Acid and of Chromium Sulphate on the Electro-Deposition of Nickel," by D. J. Macnaughtan and R. A. F. Hammond; "'Stopping Off' Materials for use in the Electro-Deposition of Nickel," by D. J. Macnaughtan and A. W. Hothersall; "The Time D. J. Macnaughtan and A. W. Hothersall; "The Time Factor in Anodic Passivation of Metals," by W. J. Shutt and V. J. Stirrup; and "The Electro-Deposition of Cobalt-Nickel Alloys," by S. Glasstone and J. C. Speakman. The first three papers represent results of the important work on electrodeposition which is being carried out in the Research Department of Woolwich Arsenal, and is being subsidised by the Electro-Deposition Committee of the Department of Scientific and Industrial Research. They deal with various phases of electro-deposition which have seen considerable development in the past few years.

Porosity of Deposits

On the subject of the porosity of electro-deposits, Mr-Macnaughtan stated that the degree of protection from corrosion afforded by a coating applied to a metal is in many cases very largely determined by the continuity of the coating and its freedom from porosity.

In the case of porous coatings which are chemically inert and electrically non-conducting the rate of corrosion of the basis metal is determined solely by the rate of direct access air and moisture to the basis metal. In the case of metallic coatings such as electro-deposits the intensity of the corrosive attack will be largely governed by electrochemical effects if the coatings are porous or in any way discontinuous. Thus, if the coating behaves cathodically towards the basis metal the corrosion of the latter will be accentuated, whilst if the coating behaves anodically towards the basis metal the rate of corrosion of the coating will probably be increased and its life in consequence shortened. The character and intensity of the corrosion of a metal coated with a porous electro-deposit is determined by the relative solution pressure of the basis metal and the coating, by the composition of the electrolyte (which in the case of atmospheric corrosion will consist of a film of moisture) by the character of the anodic and cathodic corrosion products and by the rate of access of oxygen.

In view of the fundamental difference between the manner

in which corrosion occurs at the site of pores in cathodic and anodic coatings different methods have to be employed for detecting porosity in the two types of coating.

The most generally used tests for determining the porosity of cathodic coatings are atmospheric exposure tests, spray tests (in particular the salt spray test) and the ferricyanide test. Atmospheric exposure tests, whilst of recognised importance as indicative of the probable life of an article in service, have the disadvantages as porosity tests of requiring a long time to perform, of necessitating permanent injury to the specimen and of involving factors which are difficult to control so that the results cannot with certainty be correlated with any standard. The salt spray test has been widely used for the examination of nickel and chromium coatings on steel. As a method of determining porosity it has the drawback that the large amount of corrosion product that is formed at the larger pores tends to spread over the specimen and mask the finer pores.

The ferricyanide test may be applied with the reagent diffused in a jelly or absorbed in paper. The author prefers the latter method and employs moistened paper strips impregnated with a solution containing 10 grs. per litre potassium ferricyanide, 10 grs. per litre potassium ferrocyanide, 60 grs. per litre sodium chloride.

The polishing process usually applied to electro-deposited coatings may have an important influence on the porosity of the coating. Thus, during polishing, a soft ductile deposit may be flowed over discontinuities and the porosity thereby decreased whilst a hard brittle coating may be cracked or splintered whereby the number of discontinuities is increased.

Chromium Impurities

In their account of the effect of chromium impurities in nickel deposition, Messrs. Macnaughtan and Hammond reported that chromic acid, when present even in small amounts, was found to cause a pronounced reduction of the cathode efficiency and to have a marked detrimental effect upon the character of the The intensity of the effect is influenced by the comdeposit. position of the nickel solution. Thus, in a solution containing per litre 70 grams nickel sulphate, 21 grams ammonium sul-phate and 8 grams potassium chloride which is ordinarily suitable for the production of hard deposits of nickel, 0.05 grams per litre of chromic acid causes the cathode efficiency to fall to zero; whereas in a solution containing per litre 240 grams nickel sulphate, 30 grams boric acid, 19 grams potassium chloride, which is suitable for the production of relatively soft deposits of nickel, 0.22 grams per litre of chromic acid are required to produce an equal effect on the cathode efficiency.

In both solutions, as the chromic acid is increased from zero to the amount which causes cessation of nickel deposition, the deposits become brighter and show an increasing tendency to peel away from the cathode (an effect which has been found to be due to their abnormally high stress), while discharge of hydrogen gas to an increasing extent replaces the deposition of nickel.

The nature of the basis metal is found to have an effect on the initial stages of deposition. Thus, during the first 10 minutes, the effect of chromic acid on the cathode efficiency in a nickel solution is less pronounced on copper and mercury coated copper cathodes than on nickel steel or platinum cathodes. The former metals ordinarily have a higher hydrogen overvoltage than the latter. That this is not necessarily of significance is suggested by further results in which the reduction of cathode efficiency is very high in tin and lead cathodes, which metals ordinarily have a high hydrogen overvoltage.

"Stopping Off" Materials
Research on "Stopping Off" materials used in nickel plating resulted in the following conclusions: A satisfactory material must be capable of easy application and the coating produced should preferably be (a) tough and flexible so as to withstand handling without cracking or flaking; (b) free from pin-holes or other discontinuities; (c) adherent and capable of resisting without detachment the pressure exerted by any gas bubbles that may be formed underneath its surface at the edges or at pin-holes or other discontinuities, during electrochemical cleaning; (d) not attacked chemically by the cleaning solutions; (e) not softened unduly at the working temperature of the solutions; (f) chemically inert to nickel depositing solutions.

Oil varnishes and varnishes made by the dissolution or suspension of india-rubber, gutta-percha, ebonite, bitumen and shellac in suitable volatile media produced coatings which were unsatisfactory either on account of the presence of pinholes or because of their detachment in the cleaning processes prior to nickel deposition owing to poor adhesion or to chemical A cellulose ester type of varnish known as Necol varnishes was found to form a satisfactory insulating coating, if carefully applied.

A rapid process has been developed by the authors by means of which nickel depositing solutions which have been contaminated with organic material and which in consequence yield brittle deposits may be reconditioned so as to yield satis factory deposits. The process consists in oxidation of the organic constituents by boiling with potassium permanganate (1 to 2 lb. per 1,000 gallons) followed by removal, if necessary, of any manganese remaining in solution.

Cobalt-Nickel Alloys

In the work on cobalt-nickel alloys an investigation was made of the compositions of the alloys deposited from wellbuffered solutions of definite hydrogen ion concentration containing various mixtures of cobalt and nickel sulphates at a series of C.D.'s ranging from 0.0028 to 5-6 amp. per sq. dm. The composition of the alloy at low C.D.'s was found to be almost independent of the C.D. for any given solution; beyond a certain C.D. the cobalt content of the alloy decreases.

The composition of the initially deposited alloys is independent of the hydrogen ion concentration of the solution; the current efficiency for metal deposition increases with increasing pH, and the effect of impoverishment of the electrolyte is observed at lower C.D.'s. The presence of acetate ions does not appear to have any influence on the relative tendencies for cobalt and nickel to deposit from solutions of the mixed sulphates

The investigations already made of the compositions of the alloys of cobalt and nickel deposited from well-buffered solutions of definite hydrogen ion concentration containing various mixtures of the sulphates of these metals, at a series of current densities, were extended to higher temperatures. The relative tendency for cobalt and nickel to deposit was found, as expected from previous results, to be independent of the hydrogen ion concentration of the electrolyte. deposited at very low current densities contain decreasing proportions of cobalt as the temperature is raised; this proportion is, in general, less than that in the solution for depositions made at 90° C. With increasing current density the fraction of cobalt in the deposited alloy increases rapidly until a constant maximum cobalt content, independent of current density, is attained; this maximum decreases with increasing temperature. The influence of cobalt on the deposition of nickel at 50° C. and 90° C. is very similar to that of iron at 15° C. and 50°C. respectively.

Physical Chemistry of Steel-making

American Experimental Work THE work on the physical chemistry of steel making, as carried out at the Pittsburgh Experiment Station of the United States Bureau of Mines in co-operation with the Carnegie Institute of Technology and the Metallurgical Advisory Board, has covered a series of fundamental studies on the action of oxygen in liquid steel and the application of the findings to open-hearth operation. The staff has varied from 14 to 23 men per year. In all, some 16 physical chemists and metallurgists and 24 research fellows have taken part in the experimental work. According to the Bureau of Mines Report of Investigations 3054, the general method of studying oxygen has been, first, to determine the solubility of the various oxides in liquid steel, and the solubility of FeO in steel has been determined over a wide temperature range. The straight-line relationship in the plot of solubility versus temperature indicated that under a slag of 100 per cent. FeO the oxygen was present in the steel as dissolved FeO. A further conclusion drawn from this work was that the solubility of FeO in the metal was proportional at a given temperature to the mol fraction of FeO in the slag if the slag contained a large excess of basic constituents. This result was determined

from a study of the solubility of FeO under slags containing lime and iron oxide in various proportions. These data have been used extensively in determining the saturation of a bath of open-hearth steel under any conditions of slag composition, and results showed that the solubility curves are consistent with the results obtained in practice

A study was also made of the equilibria and types of inclusions formed when highly oxidised steel was deoxidised with various alloys. Concurrently, the slag systems which were involved were studied by the synthesis of the slags in the induction former than the stage of the slags in the induction furnace and their examination under the microscope and determination of their melting points by the micropyrometer method. Up to the present time the studies have included deoxidation with silicon; deoxidation with aluminium; deoxidation with manganese; deoxidation with manganese-aluminium alloys; deoxidation with aluminiumsilicon alloys; and deoxidation with manganese-silicon alloys.

The Routine Analysis of Bronzes

[From a Correspondent.]
The following method for the routine analysis of bronzes and gunmetals has been found to give good results together with reasonable speed and is very suitable for general works Where a number of samples are to be analysed the best practice is to operate on batches of four, starting the next batch before the first is completed.

Tin

Weigh down half a gram of sample into a small beaker and dissolve in 20 ccs. of concentrated nitric acid. solution is complete dilute with hot water to about 70 ccs., bulk and allow to settle on edge of plate. Filter off the tin hydroxide, wash well and ignite at a dull red heat in mouth of muffle, cool and weigh as Sn O2.

Copper and Lead
Take the filtrate from the tin estimation and electrolyse using a gauze cathode and rotating spiral anode. The current used should be about 2 amps at 4 volts. Remove the solution when electrolysis is complete (about one hour) still keeping the current on and wash the electrodes with distilled water and afterwards with alcohol. Dry and weigh both electrodes. Increase in weight of cathode is copper and increase in weight of anode is lead peroxide.

Iron

Boil down the solution from electrolysis to about 100 ccs. bulk, add about one gram of ammonium chloride and make slightly alkaline with ammonium hydrate. Boil and allow the precipitate to settle for a few minutes and then filter off wash well with hot water. Ignite cool and weigh as

Zinc Take the filtrate from the iron estimation, add a few drops of litmus solution and adjust to very faint acidity with dilute acetic acid. Heat to boiling and then add about two grams of ammonium phosphate. Allow precipitate to settle in a warm place and then filter off and wash with hot water. Ignite at mouth of muffle, cool and weigh as zinc pyrophosphate.

Nickel Take filtrate from the zinc estimation, make slightly alkaline with ammonium hydrate and add 20 ccs. of 2 per cent. dimethylglyoxime solution. Allow to stand on plate for a short time and if a red precipitate forms it is due to nickel. Filter off, ignite, cool and weigh as NiO2.

Boiler Tube Failure

THE results of an investigation into a recent boiler tube failure on a Continental steam plant are the subject of a note in the current issue of Concord, the organ of the Liverpool Borax Co., Ltd., Feed Water Specialists Co., and Andrew Maxwell. During a hydrostatic test, it was by chance revealed that small beads of water had collected on a portion of the surface. The section of tube was cut and subjected to a higher hydrostatic test. At 3,800 lb. pressure the water issued forth in a stream from what was found to be a crease or fold, invisible to the unaided eye. The crease was traced to a flaw caused by the rolling operation in manufacturing the tubes. incident serves to illustrate the care required in selecting material for high pressure boilers.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

An opinion frequently expressed during the past few weeks has been to the effect that there is a somewhat better tone in the market and that steadier conditions are developing. Such an opinion, however, is probably due to a desire to be optimistic at a time when there is little to warrant optimism; it is significant that the reports usually end with the remark that there is no appreciable increase in the volume of business. The slight spurt of activity in the earlier part of January was really due to the accumulation of orders during the prolonged holiday stoppage. That spurt has now died away and as far as the heavy steel trade is concerned we seem to be slipping back to the unsatisfactory condition which prevailed during the latter part of 1930.

Lack of Confidence

There is not yet a return of that confidence which is necessary to make business move. The political situation may in some measure account for this. The prospects of a change in Government are more uncertain than they were a few weeks ago, and the hopes of safeguarding, which rest on a change in Government, begin to grow dim. The unsatisfactory state of affairs in Parliament is a definite hindrance to a trade revival. Also in the industry itself, the policy pursued by some of the makers is not calculated to inspire confidence. So long as buyers believe, and have their belief verified, that prices are likely to go lower, so long will business be restricted and confidence shaken. An important point is that, generally speaking, the prices of iron and steel are not fixed on an economic basis; they do not represent the cost of manufacture, but rather the extent to which the makers are willing to incur losses in order to snatch a little more business from their fellow producers. When prices show a margin of profit, however small, the exigencies of the trade situation may make it advisable to reduce that margin even to disappearing point; but when selling prices represent a definite loss it is folly to increase that loss by internecine competition, the only result of which is a general lowering of the return on the product without the slightest compensation in the shape of increased output.

Price Reductions

That foolish course is being persistently followed. pig iron makers have declared many times that prices could not possibly be reduced further, and that rather than do this the furnaces would be put out. Yet prices have been reduced, in addition to blowing out furnaces, and it is quite likely that there will be further cutting as one district endeavours to get a greater share of the trade from another. The hematite makers have closed down furnace after furnace because of the slump in trade, which could not be overcome by any price reduction, yet they have now yielded to the temptation, and within the past few days have made another reduction of 2s. per ton. Boiler plates, for which orders are as scarce as ever they were, are now being sold at £8 17s. 6d. per ton, not because they can be produced at that price, but simply because one or two makers are under the delusion that by cutting the price they can reserve to themselves a greater share of the available business. But that only lasts until the next inquiry comes along. It is the same with small steel bars. These are now being sold at £7 5s. to £7 1os. per ton, and supposedly British at that. This price applies to rounds under 3 in., yet the Association price for 3 in. round is still £9 7s. 6d., or, with the rebate deducted, £8 12s. 6d.! Sheets $\frac{1}{8}$ in. thick are sold at £9 2s. 6d. delivered, and one or two makers would not hesitate to cut that price to prevent some other works from getting the orders. One evil result of all this is that buyers are more than ever persuaded that the right course is to buy as little as possible, to make no contracts, but to hold up business as much as they can. They have no faith in the market; they feel that if they make a bulk purchase this week they will find next week that prices have fallen. If it were definitely known that prices had reached bottom, that in no case would further reductions be made, we should soon see a buying movement which might well lead to a general revival in trade; for is is surprising how small a thing will start such a movement.

Increase in Rebate

The Associated Steel makers, at their meeting on January 14, yielded to the pressure that some of the districts brought to bear, and announced an increase of 5s. per ton in the rebate, which is equivalent to a reduction of 5s. per ton in price to all consumers who comply with the conditions of in price to all consumers who comply with the conditions of the rebate scheme. The official prices remain at £8 7s. 6d. for sections and £8 17s. 6d. for plates, with a rebate of 15s. per ton instead of 10s. The price of joists was increased from £8 10s. to £8 15s., but the rebate was increased 10s., from 12s. 6d. to 22s. 6d., so that the net result is the same as in sections and plates. It would for many reasons have been better to make no change of any sort, but as that course was not acceptable to the majority, the next best thing was done by increasing the rebate instead of reducing the selling price. by increasing the reducting the sensing the sensing the sensing the reducting the sensing the reduction that the reduction is the only means the steel makers have of fighting the competition from abroad. If that competition were to be checked from another source, as for example by safeguarding, then the rebate could be reduced or taken away altogether, without increasing the official selling price. It is highly satisfactory, too, that the joint associations definitely decided that the alteration now made should be in force for six months, that is to say, the official prices and rebate are definitely fixed for a period of six months. The knowledge of that fact may induce buyers to come into the market, as they will be quite safe in contracting for their requirements to the end of June. This action of the associations does show up the weakness in the uncontrolled section, to which we have referred. If all classes of steel were controlled it would have been possible to make a general decision at the January meeting which would have brought stability to the whole market; instead of which we have one-half of the production stabilised for six months, and the other half at the mercy of those makers who still adhere to their mistaken policy of business at any price.

Awaiting Orders

The increase in the rebate has not yet led to any buying in bulk, although that may develop shortly. The whole trouble is that there are no orders about just now. The motor trade seems to be getting rather more active, and with a quickening there the effect would soon be felt in the demand for bright drawn steel and for pressings, as well as other special manufactures which in total mean a very important volume of business for the steel makers. The shortage of specifications for the rolling mills is still a source of great anxiety. One or two of the works are benefiting from the substantial order for rails for South Africa which has recently been placed, but that is a special item. Another special order which has been booked by the British Export Association is for 2,000 tons of plates for a pipe line at Vancouver. That means a welcome addition to the output of the works with whom the order is placed; but the price is a very unattractive one. The pig iron market is generally quiet; little buying is taking place, although makers are hoping for better business shortly. Semi-finished steel is a weak market. For all qualities prices have been reduced under the stress of competition. There is little change in the Continental position, but it is probable that the offer of a good order would lead to a reduction in

The 1930 Output

The output figures for the whole of 1930 are now available, and show a gradual decline in both pig iron and steel. In pig iron the output fell from 650,000 tons in January to 349,800 tons in December, and steel from 771,800 tons in January to 337,200 tons in December. The yearly totals are as under:

			1930.	1929.
			Tons.	Tons.
Pig iron	 	 	6,196,800	7,589,300
Steel	 	 	7,298,500	9,636,200

Metallurgical Topics: Monthly Notes and Comments From Our Own Correspondents

Solidification of Lead-Antimony Alloys

THE belief that lead-antimony alloys of the kind to which type metals belong expand on solidification dies hard, seeing that it is repeated in a comparatively recent book on alloys. It certainly dates back to the fifties of the last century, and, in a once popular work, "Muspratt's Chemistry" is set out explicitly as follows:—" The chief use of antimony in making stereotype plates is that, besides hardening them, it causes expansion of the alloy in cooling, and as the cooling next the type is latest, the expansion causes the metal to fill every interstice, and beautifully sharp casts result." The article on antimony in which this passage occurs is unsigned, but the contributors to "Muspratt" were amongst the best-known chemists and metallurgists of the day, and the passage quoted is interesting from the fact that one part of the explanation of something that actually does not occur is in itself very near the mark as to what does occur. Yet J. A. Smythe, in his monograph on "Lead." also makes a similar mis-state-ment in a sentence containing, once again, a half-truth, when he says (p. 222) "the expansion on solidification" (of anti-mony-lead alloys) "is a maximum at the eutectic composi-As a matter of fact, while bismuth-lead and bismuthtin alloys do expand on freezing (or somewhere so near that point as hardly to affect the argument), lead-antimony alloys do not. Now, in earlier times bismuth used to be a constituent of type metals, although for many years its use has been abandoned in making those alloys. The erroneous notion may be a survival of the typefounder's actual experience of type metal containing alloys which did actually expand on freezing, but this is not a justification for the belief, which still survives in the type foundry, that present-day type metal alloys behave in this manner.

The "Apparent" Expansion

What really happens and how the belief originated and has been perpetuated, is set out with admirable clearness in an elaborate research by Mr. W. E. Goodrich, for the Die Castings Alloys Research Committee of the British Non-Ferrous Metals Research Association, and published some time ago in the Transactions of the Faraday Society. Those still under the erroneous impression respecting the expansion, on solidification, of antimony-lead alloys would do well to study that research, which not only establishes the fact that they do not do so, but explains lucidly what they really do. Both the tin-antimony and the lead-antimony alloys were investigated in this research. The belief that tin-antimony alloys expand on solidifying appears not to be confined to type founders, for Mr. Goodrich refers to "the prevalent opinion amongst non-ferrous foundrymen that alloys which contain over 10 per cent. of antimony expand on solidifying, and says explicitly that expansion during freezing does not take place. The italics are his own. In connection with the lead-antimony alloys he again refers to the "general impression" that type metals in particular expand on solidification. It appears to have arisen from the freezing out of an antimony-rich primary constituent without any sudden change of volume, and to the very low rate of contraction of the solidified metal. moreover, the contribution of another factor which may create the appearance of expansion, and this is the segregation of the primarily deposited constituent towards the upper surface of the casting. For this reason such alloys often cool in ingot moulds with a convex upper surface, instead of piping. Piping, however, in such cases takes place internally, and there is no real expansion of the metal.

A Useful Publication

THE reissue, thoroughly revised and up to date, of the Imperial Institute publications on the mineral industry of the British Empire and foreign countries will be warmly welcomed, as the former issues, published for the most part between the years 1920–1923, have become more or less obsolete. The series of which we published an advance notice last month is to be distinguished from the useful little "Monographs" in red paper covers, which dealt with mineral resources and which, likewise, call for some revision, although this does not very clearly transpire from the list of publica-

tions appearing in the inside covers of the present issue The most considerable of the new series hitherto available deals with zinc, and its value is enhanced by the inclusion of a well-selected bibliography of books, papers and pamphlets dealing not with the industry, statistics and resources of the metal alone, but with its metallurgy, properties and applications. The resources of our own Empire being so vast, and the existence of prosperous zinc industries in Belgium and in Silesia—countries not possessing anything like our own natural advantages in the matter of zinc supplies—should encourage and stimulate the home zinc smelting industry, which has fallen on evil days. At present the bulk of the concentrates from Austria are treated in Belgium, and zinc producers in that country seem, the low price of spelter notwithstanding, to be making profits out of the industry As zinc is by way of being, in many cases, a by-product, and its minerals associated with others of greater value, its extraction at home should serve to revive some of the depressed industries of South Wales and the North East Coast. In any case the volume of the Imperial Institute shows that there is scope and prospect for building up from Empire zinc resources a home zinc smelting industry, while the example of the two European countries referred to shows that they themselves without a tithe of our resources, have succeeded in doing so.

Empire Mineral Resources

In this connection, also, we may call attention to the special exhibition, illustrating the mineral resources of the Empire, which is to be opened by Mr. Amery on February 17 next. The exhibition, although primarily intended to bring home to the general public the vast stores and great variety of to the general public the vast stores and great variety of minerals available within the Empire, will also supply information to the student of economics and even be of interest in some instances to the technical expert. It will be arranged on a geographical basis and besides the numerous mineral specimens there will be exhibited many enlarged photographs. diagrams, maps, flow-sheets, etc., illustrating the mineral industries of the various countries represented. of the active co-operation of the overseas governments concerned, mineral specimens numbering upwards of two thousand have been specially sent to supplement those already available at the Imperial Institute. Among the exhibits from newly developed areas, the copper ores of Northern Rhodesia will be fully represented and representative samples of the Postmasburg manganese ore. Bushveld platinum ore and concentrates. Sierra Leone platinum nuggets, Kirkland Lake gold ores. Tanganyika coals, Indian asbestos and of many other recently developed or recently discovered deposits will be included.

Building for the Boom

When trade is slack many firms sit still, waiting and wishing for better times. Others with a more optimistic outlook seize the opportunity to think out and organise for the trade expansion that is bound to come, and thus give an impetus towards better conditions. Organisations with this far-seeing and confident outlook are generally those that get going quickest and make most headway when trade begins to boom. An instance of this is provided by the new building which G. A. Harvey and Co. (London), Ltd. are adding to their already extensive works, which cover 27 acres at Woolwich Road, London. The new building is to be constructed to meet the requirements of their steel plate construction and steel furniture and equipment departments. Several hundred concrete piles have already been driven to ensure a foundation sufficiently firm to bear the heavy machinery that is to be installed.

It is only two years since a large extension was made to the Harvey works, but the rapid development of the two departments mentioned has necessitated this new development. A great demand has sprung up for steel equipment for offices, factories, warehouses, hospitals, libraries, and public buildings, and it is now also being adopted for domestic uses as, apart from its utility, it has been found to suit many up-to-date architectural and decorative schemes. The new building, which is to be 300 ft. long, 250 ft. wide, and 65 ft. high will give increased facilities both for the production of steel furniture and for the manufacture of every description of

Russia's Production of Metals

Extensive steps are being taken by Russia to utilise her own vast supplies of metals and render her independent of outside sources. At present she is suffering from a metal shortage, but a considerable increase in production is being put into effect. Information given out by a leading Russian official foretells the following increases in metal production by 1932—copper from 46,000 to 200,000 tons, lead from 6,000 to 143,000 tons; metallic zinc from 12,000 to 135,000 tons. It is also hoped to produce 2,500 tons of nickel, 500 tons of mercury, 20,000 tons of aluminium, 1,000 tons of metallic magnesium, 1,000 tons of antimony and 1,000 tons of tin. In a comment on these figures the Berliner Tageblatt states that they represent remarkable increases in present production, but are much above present consumption, including imports. If the plans can be carried out, Russia undoubtedly will export copper, lead, zinc and possibly aluminium. It seems impossible that such quantities could be utilised so soon in Russian industry, and, therefore, it is not likely that these figures actually will be reached by 1932.

Cobalt Alloys

ALTHOUGH the metal cobalt is not yet widely used commercially in its pure state, it is an important constituent of several classes of alloys. The hard cutting tool material known as stellite contains at least fifty per cent. cobalt together with chromium and tungsten, and the manufacture of this alloy absorbs a considerable quantity of the metal. Another high cobalt alloy which may be mentioned is ferro-cobalt, used in the making of cobalt steels, and this usually contains upwards of eighty per cent, cobalt. The cobalt steels at present in use are those having particularly useful magnetic properties, and up to 35 per cent, cobalt steels have been suggested for magnetic purposes. Such steels are expensive, however, but in numerous cases the increased cost is more than balanced by the improved physical properties. Several modern high speed steels also contain some cobalt, in some instances amounting to several per cents. It is quite probable that further developments in the use of cobalt in steels may be expected in the future.

Uses in Industry

THE use of cobalt in electro-plating has received considerable attention in recent years, and some of the latest research in this field is dealt with elsewhere in this issue. Another development which makes use of cobalt is the material of the Widia class, a very hard cutting tool tip material consisting essentially of tungsten carbide together with a small amount of cobalt. Several of these alloys contain five per cent or more of cobalt. Of the useful chemical compounds of cobalt employed in industry, the chief are the oxides and silicates, which are used in ceramics for colouring glass and pottery, and also for pigments. In conclusion, numerous other alloys have been suggested from time to time amongst which may be mentioned cobalt-tungsten, cobalt-tungsten-iron, cobalt-chromium, and iron-nickel-cobalt alloys, the latter having a very low expansion The addition of small amounts of cobalt to brasses co-efficient. is claimed to have a beneficial effect. The high cost of cobalt, however, seems to go against its widespread use, but there can be no doubt whatever that, in view of modern research, cobalt is likely to be a very useful metal, in spite of its cost.

Electro-plating

The collaboration of Mr. Samuel Field, the head of the Chemistry Department of the Northampton Polytechnic, and Mr. A. Dudley Weill, the technical director of a well-known firm of electroplaters has resulted in the publication of a wholly admirable little book (Electro-plating: Sir Isaac Pitman and Sons, Ltd., price 5s. net) on a subject, the theory and practice of which have alike made enormous strides since the war. Although there are a number of excellent papers which deal with the art, many of which have been contributions made to the proceedings of the Electroplaters' and Depositors' Technical Society, of which Mr. Field was the founder and from the presidency of which he has but recently retired, the number of books on electroplating is not large. Most of them, too, are high priced, and beyond the reach of working platers. Hence the new book will be most welcome to those who are desirous of grafting on their empiric knowledge of the art the elements of the science upon which it rests.

Some Inventions of the Month By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in The Chemical Age.

Aluminium

In the electrolytic reduction of alumina a mixture of aluminium fluoride and sodium or potassium carbonate or hydroxide is used as a flux instead of cryolite. The fluoride used may be dry or moist, and the preferred molecular proportions are 4 of the fluoride to 3 of sodium carbonate. See Specification 338,084, bearing the International Convention date March 15, 1929, by Compagnie de Produits Chimiques et Electrometallurgiques Alais, Froges et Camarque of Paris.

Electrolytic Deposition of Tin

To obtain a thick, coherent, firmly adherent deposit of tin in the electrolysis of alkali metal stannate or stannite lyes with the use of soluble anodes, the free alkali content of the electrolyte, inclusive of that set free by hydrolysis, but not including alkali metal carbonate, is kept below about 1.5 per cent. The current density may be 50–1600 ampères per square metre and the concentration of tin in the electrolyte may be 0.05 per cent. or higher. See Specification 338,488 (Mellersh-Jackson), dated May 16, 1929, a communication from Siemens and Halske Akt.-Ges. of Berlin.

Heat Treatment of Iron and Steel Alloys

A METHOD of annealing articles made from iron or steel alloys containing 8–20 per cent. of chromium and 1–3·5 per cent. of carbon, with or without up to 6 per cent. of cobalt and up to 1 per cent. each of nickel, vanadium, molybdenum, silicon, or manganese, is described in Specification 338.912, dated August 28, 1929, by P./R. Kuehnrich and Darwins, Ltd. of Sheffield. The articles, which may contain less than 0·05 per cent. each of sulphur and phosphorus as nonessential impurities, are hardened and rendered stainless and rustless by heating, preferably in a reducing or inert atmosphere or in a salt bath, to 1,150–1,250° C., and, when uniformly at this temperature, cooling at a definite rate corresponding to the rate at which sheet steel of 18 gauge cools in water at normal temperature. Thus articles in sheet or strip form of a thickness not exceeding 18 gauge are quenched in water at 15° C; for articles of a thickness up to 12 gauge such as spoons and forks, a solution of calcium chloride or sodium chloride is used; for castings generally iced water or an iced chloride solution is used.

Protection of Iron and Steel against; Corrosion

A process of treating iron and steel articles to prevent their corrosion is described in Specification 337,562, dated October 10, 1929, by A. Folliet and N. Sainderichin of Paris. The articles are heated at 850–1,050° C. in a mixture of (a) finely granulated aluminium free from copper or zinc and containing not more than 6 per cent. of alumina as impurity; (b) an inert support of high thermal conductivity, e.g., crystallized carborundum free from graphite; and (c) one or more chlorides of chromium, nickel, manganese, or other non-ferrous metals capable of alloying with iron. The inert support constitutes $\frac{a}{b} - \frac{a}{b}$ of the volume of the mixture, and the chloride ingredient 2–5 per cent. by weight. Double chlorides of the metals with alkali metals or ammonium may be used and 1–2·5 per cent. of dry ammonium chloride may be added. The articles become coated with an alloy of iron, aluminium, and the metal or metals in the chloride ingredient.

Refining Iron and Steel

For the production of non-siliconized iron or steel adapted for easy welding, the carbon content of the bath is reduced to about 0.02 per cent., whereafter there is added in the furnace or ladle an aluminium-silicon alloy of a composition such that it readily slags off. Low-carbon manganese may be added to facilitate working of the product, which may contain approximately 0.02 per cent. of carbon, 0.5 per cent. of manganese, 0.09 per cent. of copper, 0.02 per cent. of phosphorus, and 0.003 per cent. of sulphur. See Specification 336,954, dated July 18, 1029, by H. Hagemann, of Essen, Germany.

Testing Iron Alloys

A METHOD of ascertaining rapidly the rusting tendency of iron alloys is described in Specification 338,071, bearing the International Convention date January 30, 1929, by Vereinigte Stahlwerke Akt.-Ges. of Dusseldorf, Germany. The power of the material to withstand vibration stresses is first tested in the normal way, whereupon the test is repeated while the material is exposed to the corrosive action of water or moist air. The amount by which the resistance to fatigue stresses is reduced is regarded as a measure of the rusting tendency, and the information thus obtained is of value in the manufacture of the alloys.

Treating Sulphide Ores

BLAST-SMELTING of sulphide ores-e.g., of zinc, tin, lead, bismuth, cadmium, arsenic or antimony-is effected in a rotary furnace in the form of a short drum of a diameter about equal to its length. The drum is closed at one end, so that the flame must enter and leave by the same side, and air is blown on or into the melt until oxidation of the iron com-In the treatment of an ore containing pyrites and zinc blende the oxidation generates so much heat that further external heating is not required. The addition of small quantities of lime to form calcium ferrite prevents any stiffening of the melt, and the addition of a small quantity of coal prevents the taking up of zinc oxide by the calcium ferrite The process may be accelerated by the addition of small amounts of pig iron or iron oxide to liberate zinc, which burns to the oxide with generation of heat. When iron and copper are present a copper-calcium ferrite slag is produced, and the copper may be separated therefrom as a matte by treatment with added sulphur-e.g., in the form of pyrites. See Specification 336,670, dated July 19, 1929, by E. J. Kohlmeyer, of Berlin.

A process for making tungsten ingots free from residual oxygen is described in Specification 337,160 (Gray), dated October 3, 1929, a communication from A. Pacz, of Metallges, Frankfort-on-Main, Germany. Tungsten powder is intimately mixed with a more volatile metal such as silver, and the mixture is compacted and sintered with volatilization of all the added metal, leaving an ingot of unworked pure tungsten, suitable for making filaments, spark points, make-and-break contacts, etc. Alternatively a mixture to be compacted may be obtained by reduction with hydrogen of (a) an intimate mixture of tungstic oxide and a reducible silver compound such as silver chloride, or (b) a precipitate obtained by adding solutions of silver nitrate and sodium tungstate simultaneously to dilute hydrochloric acid, or (c) a product obtained by adding silver nitrate solution to sodium tungstate solution and treating the precipitate with hydrochloric acid. The product may be made to contain over 1.5 per cent. of thoria.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BRITISH AND DOMINIONS FERALLOY, LTD., London, S.W. Registered January 1, £500 secured notes, part of

£15,000; general charge. *£8,800. November 21, 1930. BRITISH (NON-FERROUS) MINING CORPORATION, LTD., London, E.C. Registered January 2, £250,000 convertible income debenture stock (secured by Trust Deed dated December 30, 1930); charged on certain shares, etc., also general charge. *Nil. December 31, 1930.

DORMAN LONG AND CO., LTD., Middlesbrough, steel

manufacturers. Registered December 31, £804 18s. mortgage

(sec. 81, 1929 Act), to Newcastle-upon-Tyne Permanent Building Society; charged on 3, Pelaw Terrace, Durham. *£5,846,273. December 31, 1929.
HIRST, IBBETSON AND TAYLOR, LTD., Manchester,

ironfounders. Registered December 23, £7,000 1st debentures, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general

charge. *—. July 23, 1930.

LAKE COPPER PROPRIETARY CO., LTD., London, E.C. Registered December 30, £5,000, £1,200, £20, £680 and £10,000 debentures (dated November 30, 1923, to January 23, 1928), part of £500,000; general charge.

NEW GOLDFIELDS OF VENEZUELA, LTD., London, E.C. Registered December 13, £130,000 (not ex.) debenture stock and 5 per cent. premium (secured by Trust Deed dated December 4, 1930); charged on various mining properties, also general charge.

also general charge. *—. October 13, 1930.

NORTHERN REFINING AND MANUFACTURING CO.
(LANCASHIRE), LTD., Liverpool. Registered December 29, 100 debenture to R. Williams, 66, Laurel Road, Liverpool; December 31, 1929. general charge.

PARTINGTON STEEL AND IRON CO., LTD., Warrington.—Registered December 30, Trust Deed dated December 22, 1930 (supplemental to Trust Deed dated December 13, 1928), securing £202,301 income debentures (to be exchanged on or before June 30, 1933, for £183,910 1st debenture stock) in addition to £1,000,000 already registered; charged on certain shares, etc., also general charge; also registered December 30, Trust Deed dated December 22, 1930, providing for the exchange of £183,910 1st debenture stock outstanding for

change of £183,910 1st debenture stock outstanding for income debentures as above; charged on certain shares, etc., also general charge. *£1,187,135. November 10, 1030.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington.—Registered December 30, Trust Deed dated December 22, 1930 (supplemental to Trust Deeds dated February 9, 1922, etc.), securing £480,000 income debenture stock in addition to £1,270,000 already registered; charged on certain shares, etc., also general charge. *£1,441,050.

November 10, 1930. SIPUT TIN CO., LTD., London, E.C. Registered January 7, charge, collateral to 440,000 debenture dated October 15, 1930, to Guthrie and Co., Ltd., Singapore, and 5, Whittington Avenue, E.C.; charged on certain mining leases in Kuala

Kangsar. *£40,000. October 29, 1930.
WILUNA GOLD CORPORATION, LTD., London, E.C.-Registered January 6, £350,000 notes and 20 per cent. premium (secured by trust deed dated December 18, 1930), present issue £300,000; charged on certain shares and moneys due or to become due to company, also general charge. October 9, 1929.

Satisfactions

BWANA M'KUBWA COPPER MINING CO., LTD., London, E.C.—Satisfaction registered January 13, £779,500,

part of amount registered April 13, 1928.

COOKSON AND CO., LTD., Newcastle-on-Tyne, smelters. Satisfaction registered January 8, £8,900, part of amount

registered March, 15, 1920.

JOPLING (E.) AND SONS, LTD., Sunderland, steel manufacturers. Satisfaction registered January 12, £20,000, registered November 20, 1922

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington.—Satisfactions registered December 30, £500,000, registered December 18, 1928, and £50,000, the whole amount issued of £250,000 debenture stock registered December 21, 1928.

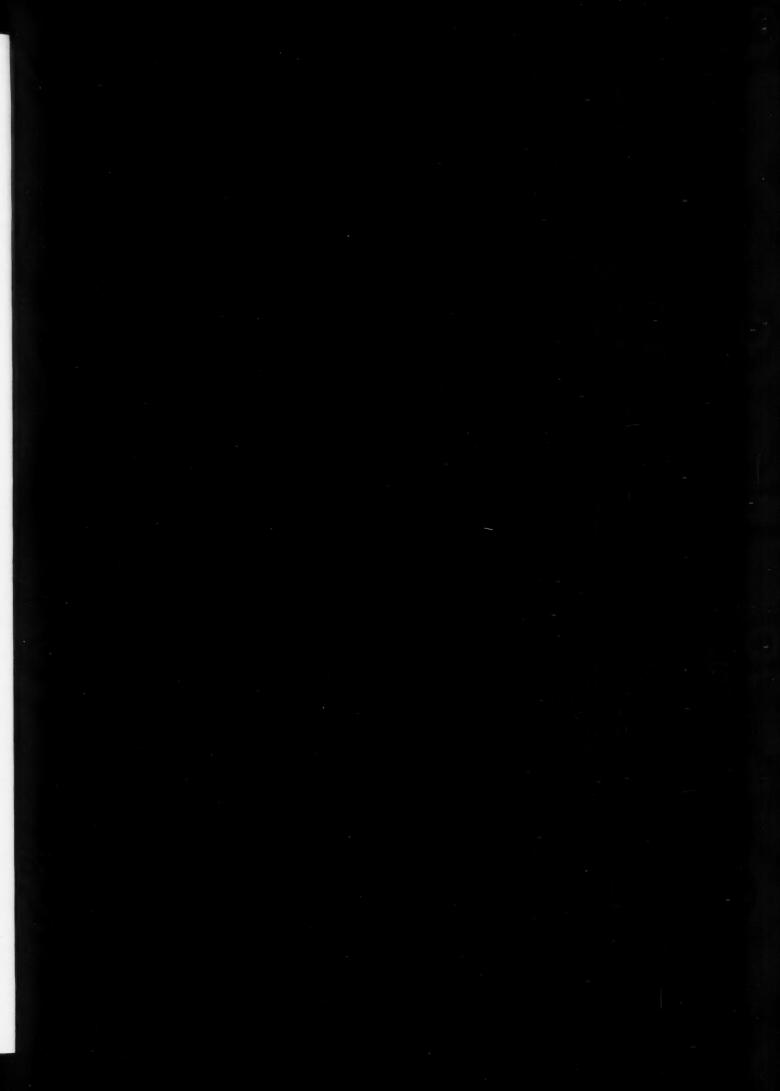
London Gazette, &c.

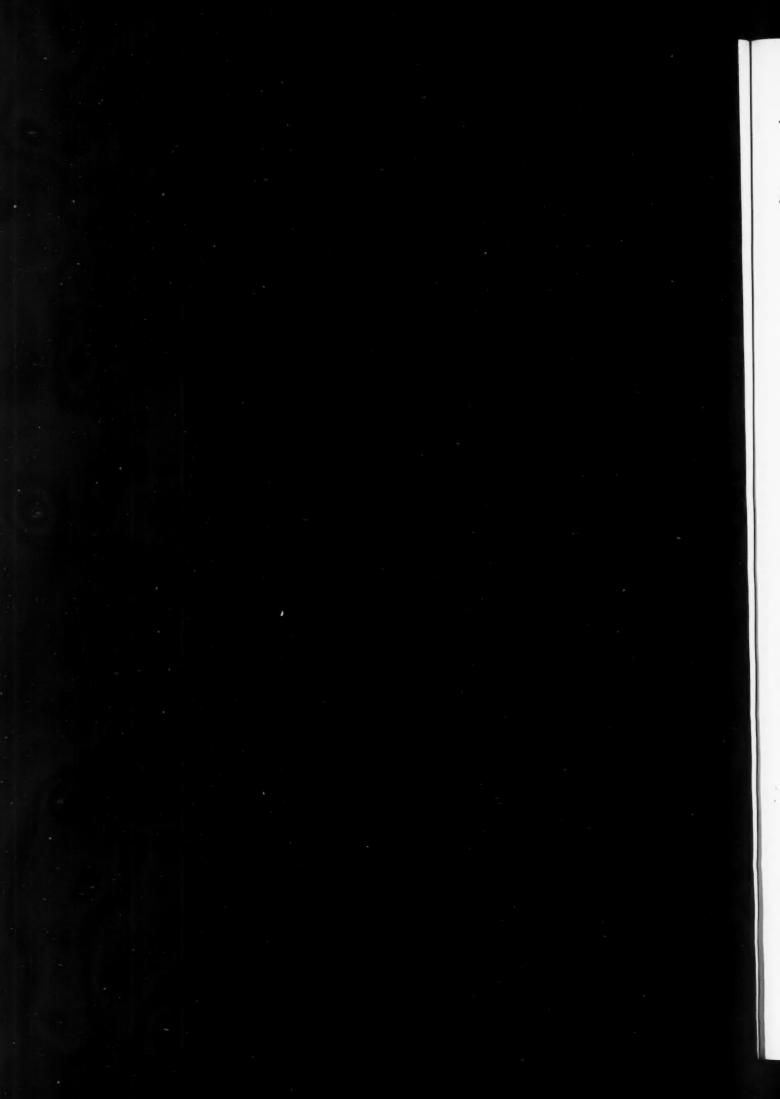
Companies Winding Up Voluntarily

BRYN GWIOG MINES, LTD. By special resolution. December 31. Walter Conway, of 8, Old Bank Buildings,

Chester, chartered accountant, appointed as liquidator.
NYASALAND MINERALS, LTD. By reason of its liabilities. December 31. L. B. Armstrong, certified accountant, of 3, Thames-house, Queen Street Place, London, E.C.4, nominated liquidator.

RINGAROOMA TIN (ALLUVIAL), LTD. By reason of its liabilities. January 15. G. D. Cahill, F.A.A., of 76, Finsbury Pavement, London, E.C.2, appointed as liquidator.





Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor,
The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and
other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points
of interest to metallurgists bearing on works practice or current research problems.

The Use of Vanadium in Tool Steels

Alloys with Valuable Properties

The properties conferred by vanadium on the various classes of tool steels and the percentage composition of different alloys are dealt with in the following article which is taken from the current issue of the "Vancoram Review," the organ of the Research Department of the Vanadium Corporation of America.

Steels for tools quite logically arrange themselves in three broad groups—the carbon, the low-alloy and the highly-alloyed tool steels. In each of these vanadium plays a most important rôle, conferring distinctive properties that are

important rôle, conferring distinctive properties that are vitally necessary and not otherwise obtainable.

Despite the advent of complex compositions of greatly enhanced cutting ability, improved compressive strength, special mechanical properties at high rates of performance and the consequent higher temperatures, carbon tool steels still constitute a tremendous tonnage and occupy fields of use from which they will be difficult to displace. These steels, from which they will be difficult to displace. These steels, however, suffer from three serious shortcomings—difficulty in the maintenance of fine grain size, variability of depth of hardening and narrow hardening range. While the first two have to some degree been placed under control by tool steel makers through rigid supervision of various phases of melting, casting and hot working practices, the continued maintenance of a narrow standard of acceptability by such methods is still of a narrow standard of acceptability by such methods is still imperfect. Furthermore, the effects of such control are foreign to the inherent grain growth characteristics of carbon tool steel upon heating to temperatures much above that required for full hardening of light sections; the third difficulty is thus not overcome by control of processing. And conditions of this sort are very frequently encountered-shops or jobs in which accurate temperature control is not or cannot be secured, heavy sections in which temperatures must be increased in order to secure hardening at all. Long experience has demonstrated the effectiveness of vanadium in avoiding these handicaps, the additions to carbon steel ranging from 0·15 to 0·35 per cent., generally close to 0·25 per cent. With such an addition, grain size is always small, depth of hardening neither shallow nor great but moderate and uniformly so, while the range of hardening temperatures within which fine grain size results is so greatly increased as to permit applications not otherwise possible. With this consistently fine grain and depth of fully hardened layer, a degree of toughness and impact strength is secured that is not regularly approached by simple steels.

Increased Toughness

In conjunction with other alloying elements in relatively small amounts, vanadium has likewise been demonstrated to have very salutary effects, principally increasing toughness by the maintenance of fine grain size, by improved primary carbide distribution and by direct alloying effect, as well as increasing stability at elevated operating temperatures.

Important among the low-alloy steels are those of the non-deforming type, essentially slightly hyper-eutectoid steels of 1.00 to 1.75 per cent. manganese with small additions of tungsten, chromium and vanadium, either alone or in combination. Another of equal importance and almost equal age is the medium-carbon tungsten-chromium-vanadium steel that has been for many years almost standard in the manufacture of pneumatic chisels, punches, and other battering tools. While varied somewhat by different manufacturers the average composition is usually close to 0.45 per cent. carbon, 2.50 per cent. tungsten, 1.25 per cent. chromium and 0.25 per cent. vanadium. Recently this steel has been severely challenged by another of very remarkable properties and containing 0.50 per cent. carbon, 0.00 per cent. manganese, 1.85 per cent. silicon, 1.30 per cent. molybdenum

and 0.35 per cent. vanadium. For some special applications involving less severe duty, the molybdenum content has been greatly lowered, while for more exacting demands the carbon content has been slightly raised.

Die Steels

Low-alloy die steels have also found vanadium a very necessary addition. One of the most successful for extremely severe hot-forging operations analyses approximately 0.55 per cent. carbon, 1.25 per cent. nickel, 0.65 per cent. chromium, 0.20 per cent. molybdenum and 0.20 per cent. vanadium. Another, in wide use for many years, and generally applied to the production of forms of high precision simulates in composition the high speed steels although with smaller amounts of all the hardening elements. For cold-working dies much use has been made of a straight chrome-vanadium steel. The carbon content is adjusted to the tool section and the service demanded, while the resultant product is employed not only for compression tools, but for cutting and miscellaneous hand tools as well. It likewise produces ball and roller bearings of a quality not obtainable with plain chromium steel. In another class of die service, namely in the die-casting industry, there has been almost standardisation upon a 0.50 per cent. carbon, 2.25 per cent. chromium and 0.20 per cent. vanadium steel. Only for extremely long service on aluminium-base alloys is this practice departed from, the steel then carrying rather large amounts of tungsten

and chromium with vanadium and sometimes a little cobalt. One other very important class of tool steels containing small amounts of alloying elements are the finishing steels of carbon content of 1-20 to 1-50 per cent. tungsten 2 to 7 per cent. with variable smaller amounts of other elements but mostly containing appreciable vanadium up to 0-35 per cent. For high-speed, light cuts and fine finish of the product, these are unsurpassed and find particular use in automatic and semi-automatic machinery.

While the highly-alloyed tool steels are principally the high-speed steels, one other important though commercially smaller group falls within this designation. These are the very high carbon chromium steels that have proved so eminently satisfactory in the form of cutting dies, sheer blades, and other parts demanding extreme resistance to abrasion. Originally they were ternary steels containing 2 oo to 2 50 per cent. carbon and from 11 o to 16 o per cent. chromium. Recently they have been greatly benefited in respect to homogeneity, machining qualities and deformation in hardening without sacrifice of wear resistance by fixing the chromium close to 12 o per cent., lowering the carbon to as little as 1 50 per cent. and adding molybdenum or cobalt along with vanadium, the latter in amounts close to 1 to per cent.

High Speed Tool Steels

High speed tool steels employ vanadium in larger proportions than do any other steels. They vary widely in composition and while foreign practice, due to less severe engineering demands, recognises a grade containing little if any vanadium, no American steels made for heavy duty or high-speed metal cutting contain less than 0.50 per cent. and almost invariably not less than 0.80 per cent. Compositions vary somewhat with individual manufacturers, but in general conform to rather close limits. All contain approximately

0.60 to 0.75 per cent. carbon and very close to 4.00 per cent. chromium. The most widely used type carries in addition a mean of 18.0 per cent. tungsten and 1.0 per cent. vanadium. The reason for the very wide application of this composition is its insensitivity to rather large deviations in the hardening temperatures, differences of somewhat over 100° F. in the hardening range producing little effect upon its cutting qualities. Another important type differs in containing about 12.0 to 14.0 per cent. tungsten and 2.0 per cent. vanadium. It suffers from a narrower hardening range but has been adopted by manufacturers equipped for precise control, as it is capable of much greater cutting efficiency in rough turning than the high tungsten low-vanadium type. Cobalt has been added to steels of intermediate and also the high tungsten type. In amounts of 3 to 5 to per cent. it further increases cutting properties and overcomes the heat-treatment shortcomings of lower-tungsten steels; with 8'0 to 12.0 per cent., it becomes possible to economically machine extremely hard and tough steels. Complete success of these cobalt steels, however, requires vanadium in amounts somewhat in excess of 1 o per cent. and in tools that cannot be ground on all surfaces, the necessary precautions against decarburisation, which occurs readily at heat treatment temperatures

Though not at all steel in any of their several forms the new tool materials composed principally of hard carbides are so rapidly entering the field of the older tool steels that they deserve brief mention in this article. Just as the advent of high speed steel momentarily seemed to, though actually did not, supplant carbon steels but rather greatly broadened the application of metal cutting, so these new products of "powdermetallurgy" may be expected ultimately not so much to make inroads upon the sphere of high-speed steels as to open new fields in which cutting by machine tools is not now commercially practicable. And in them metals other than tungsten and cobalt may ultimately occupy a prominent rôle.

Influence of Metal Prices on Chemicals The Trend in 1930

The extent to which the ruling prices for tin, zinc, lead and copper influence the quotations in the heavy chemical markets, is the subject of an article in *Chemical Markets*. Few chemical consumers, even those dealing in large tonnages, produced directly from metals, it is stated, follow the trend of the metal markets, or are even reasonably well informed on metal statistics and the probable trend in prices. Yet, such information is vital to intelligent and economical purchasing of many of the most important heavy chemicals. Often price changes in industrial chemicals can be foretold with reasonable accuracy several months in advance from a thorough knowledge of metal prices and an understanding of metal statistics.

A comparison is given of the price variations of different metals and allied chemicals in 1930 showing the following percentage loss in each case:—

	Per		Per
Metal	cent.	Chemical	cent
Lead	. 20	Acetate	21
Zinc		Oxide	
Copper		Sulphate	20
Tin		Tetrachloride	34

Further investigation of these figures disclose some very interesting comparisons. The lead salt in its 1930 decline comes closest to the drop in the metal. But lead is next to the cheapest of the group of four metals. Again the lead salt is the only chemical of the four compared to have a larger percentage loss than its corresponding metal. In the case of the others, the percentage of loss in the metal is far greater than for its chemical derivative. In the case of zinc, for example, the loss is greater by more than 50 per cent. This would seem to indicate, other factors remaining stable, the possibility of lower prices in such chemicals as use these metals as a base.

A recent survey of 1930 prices of 15 representative chemicals made by *Chemical Markets* shows an average decline of only 7·3 per cent., while general basic commodities of all types declined 23·6 per cent. The average loss for the four metals amounted to 37 per cent., and their representative chemicals 24³/₄ per cent. Thus it is quite evident that not only have the baser metals declined proportionally greater than "all commodities," but also that industrial chemicals derived from

the combination of a metal (tin, copper, lead and zinc) and non-metal have shown a much greater loss than the general average of all types of industrial chemicals.

Of the four metals under consideration, lead was less severely affected by the 1930 depression than either copper, zinc or tin.

The output of lead was only 15 per cent. below the 1929 total, zinc showed a reduction of 20 per cent. and copper 19 per cent.

A study of the comparative shrinkage of metal prices during the year shows that of all of the non-ferrous metals, zinc has suffered most severely during the current slump in world trade. While it is quite true that copper, lead and tin have descended to abnormal low levels, yet the 1930 average zinc price was lower than in any preceding year ever recorded. Previous to last year's new low, the low record was held by the 1884–1886 period.

The stocks of zinc on hand as of November 1, 1930, indicated a little over a month's supply in Europe and more than four months' supply in the United States, which had about 60 per cent. of the world stocks.

Reasons for Zinc Weakness

When reasons for the weakness in zinc prices are sought it is found that, in addition to over-production in the face of diminishing demand, in the last three years a major change has taken place in the zinc industry itself. Fundamentally the cause was the introduction of the selective flotation treatment of ores. Now it was a very simple problem to handle complex ores which had heretofore defied treatment. Further, this process caused the operation of many lead-zinc properties that were formerly unprofitable, with zinc becoming a byproduct of lead. At many lead refineries, the zinc is considered purely as a by-product, and any proceeds derived from its sale as being just so much additional profit. Further still, the introduction of the electrolytic method of production is expanding at the expense of the distillation method.

Efforts were made during 1930 to bring production of each of these four metals more closely in line with actual needs. Some definite gains were made, but actual results fell far short of the anticipations of the producers. Tin producers met quite early in the year at London and agreed upon curtailment. So far short were they, however, from accurately gauging the drop in consumption that in less than six months several of the more important members of the cartel were

several of the more important members of the cartel were urging a further restriction of 25 per cent.

Copper producers in the United States finally agreed to a curtailment of approximately 20,000 tons a month in the latter part of the year, but apart from aiding in temporarily halting the decline in price the result of such action appeared to gain little towards bringing stocks more nearly in line with immediate needs. It must be remembered that the copper situation is further complicated by the fact that copper is on the free list and as such must compete with the world markets whereas both lead and zinc are afforded tariff pro-At the moment it would appear that lead appears he best statistical position of the four metals. While to be in the best statistical position of the four metals. While the immediate position of the tin market is unfavourable it is more likely that any scheme of curtailment will be more faithfully and effectively carried out than in the case of the other non-ferrous metals, as the number of producers and producing countries are fewer. In the case of copper a revival of building activity on a broad scale would undoubtedly improve the statistical position of the metal. The future for improvement in the zinc market appears to be more serious.

University Metallurgical Conference

STUDENTS from the Universities of Birmingham, Cardiff, Sheffield, Swansea and Liverpool and the Royal School of Mines were present in Birmingham last month at the Inter-University Metallurgical Societies' Conference, which has now become a well recognised event. Professor D. Hanson, Professor of Metallurgy at Birmingham, said the University Societies' movement was growing and was having a definite influence on the growth of metallurgical departments and metallurgical education. Several of the delegates gave details of the activities of the societies at the various universities, and the conference entered into a full discussion on the manner in which their work could be extended. It is felt that such an extension could do much to bring about an improvement in the status of the metallurgist.

Metallurgical Topics: Monthly Notes and Comments From Our Own Correspondents

Pressure Die-Castings

With a few noteworthy exceptions, for which the fullest credit must be given to the enterprising firms which exhibited them, pressure die castings can hardly be said to have had justice done to them at the British Industries Fair. The technique and practice in pressure die casting has made much progress, during the last few years in this country. The reproach that British industrialists have neglected this cheap, rapid and efficient mode of producing repetition work in small and medium-sized metal parts—heard as recently as two or three years ago—has, in great measure been removed since then. Yet the progress made in manufacturing processes has not been reflected, in the proportion it deserves, by the trades for which pressure die manufacturers are now prepared to cater, although those who do use them have found them in every way most suited to their requirements. Even castings of the most intricate shape, with walls of varying thicknesses, are successfully accomplished by pressure casting, while the range of metals and alloys to which the process can be adapted increases steadily.

The Zinc-base Alloys

The light metal castings cast, under pressure, in dies, have made more headway in public favour, and are being more extensively used than the heavier alloy metals. The merits, more particularly, of zinc base pressure die castings, are still insufficiently appreciated. One range of these alloys, containing a high percentage of aluminium, and from 1 to 5 per cent. of copper, came into disrepute some eight or ten years ago. They had been misdescribed as aluminium alloys, and nearly involved that useful category of light metals, when used for pressure die castings, in the same disrepute as well. The latter have lived down that unfortunate event, but it would appear that the now equally ill-founded prejudice against zinc base castings still, to some extent, survives. Given zinc of a high degree of purity—the first and most essential condition, being correctly proportioned amounts of tin and copperalloys with good casting properties can be obtained. Aluminium additions in such alloys introduce complications, and are rarely beneficial. The complications become accentuated are rarely beneficial. The complications become accentuated if lead, or possibly cadmium, is present. Magnesium, however, seems to improve zinc base alloys which contain aluminium. One advantage of the heavier (high zinc) pressure die casting alloys is the very close grain and density of the metal which results in a high degree of non-porosity rendering such zincbase die castings particularly suitable where heavy hydraulic pressures have to be withstood, as in the case, for example, of jack parts, which can be very satisfactorily cast in such alloys.

Revived Interest in Silver

An unusually large proportion of the papers to be read at the Annual Meeting of the Institute of Metals on Wednesday and Thursday next deal with various aspects of the metallurgy of silver, and its alloys. It would seem that a timely revival of interest attaches to this metal coincident with the price decline, which has already brought it within the range of industrial metals. The papers referred to include one on "The Constitution of the Cadmium-Rich Alloys of the System Cadmium-Silver," by Dr. P. J. Durrant; one by T. P. Hoar and R. K. Rowntree, on "The Silver-Rich Aluminium—Silver alloys above 600° C.", and one by Dr. D. Stockdale on "The Solid Solutions of the Copper-Silver System." Two other papers, by Dr. Elam and Dr. Gough respectively, deal with the Microstructures of Greek Silver Coins (500 to 300 B.C.), and "The Mode of Deformation of a Single Crystal of Silver The inclusion of the paper on cadmium silver alloys recalls the hopes that used to be entertained that within that range of alloys would be found the long-sought "stainless silver," which has been the aim of many patient investigations. Of the desirability of such an alloy there can be little question. The intrinsic, even if reduced, value of silver has always endeared that metal to collectors while, in spite of the attractions of stainless steel and of high quality silver plate, solid silver is still coveted in the household.

Untarnishable or "Stainless" Silver

Tarnish is of course the household bugbear, and in our cities silver tarnishes badly, and requires constant cleaning. Of the silver alloys from which a non-tarnishing silver has been hoped for, those with cadmium and zinc have been the most promising but they have a low tensile strength. That property can be improved by the addition of antimony, or tin, or both. gold their tarnish resistance is even better, but their price would be prohibitive. Jordan, Grenell and Herschman, in an elaborate research carried out for the Bureau of Standards, Washington, found that none of the alloys experimented with could be described as non-tarnishing, but many of them were distinctly more resistant to the laboratory sulphur-tarnish tests than ordinary sterling silver. That silver-copper alloys in which the silver percentage falls considerably below that of sterling, tarnish is shown by the unpleasant appearance of our own present day "silver" coins which contain only our own present day "silver" coins which contain only 50 per cent. of silver. Such an alloy would scarcely be prized for household silver, either for its value, or for its tarnish resistance, which is very low. A "stainless" silver would, for the sake of associations, need to be but little short of the sterling percentage of silver, to be valued for its own sake. It is possible yet, that the cadmium-silver alloys will solve the problem, although tarnish resistance is now regarded as having a relation to the oxygen content of silver, and cadmium is therefore assumed to act rather as a deoxidiser, than directly as an anti-corrosion addition.

The D.S.I.R. Report

A considerable amount of highly interesting research in metallurgical fields is described in the annual report of the Department of Scientific and Industrial Research for the year ended March 31 last. Particularly striking have been the achievements in reconditioning and preserving metallic articles of historical value at the British Museum laboratory, although the greater importance attaches to the fundamental researches on the behaviour of metals at high temperatures and on light alloys at the National Physical Laboratory. This is but one side of an extremely valuable report, lengthy extracts from which will be found elsewhere in this issue.

A New Aluminium Coating Process

Aliting," a process for coating iron with aluminium for the purpose of increasing the heat-resisting properties of iron parts, is the latest addition to the nomenclature and to the long list of methods of coating one metal with a film or layer of another. It has some resemblance to calorising, which can be effected in two ways, one of which resembles the sherardising process, except for the fact that aluminium powder is substituted for zinc dust, and the other of which is effected by dipping iron into molten aluminium and thus coating it in the manner of galvanising with zinc. The term aliting emerges from an account which appeared recently in Stahl und Eisen, descriptive of experiments carried out by Dr. A. Hauttmann on alloying aluminium with iron. The iron selected was "Armco," which in the earlier experiments was simply fused with aluminium, to produce alloys with from slightly under 2 per cent. of aluminium up to 38.32 per cent. The higher aluminium alloys, tested for increase in weight due to oxide formations withstood very well temperatures up to 1,000° C. The aliting coatings in the later experiments were produced by heating the Armco iron in powdered ferroaluminium (52 and 59 per cent. aluminium), in which case diffusion into the iron occurred, and also by dipping in molten aluminium (which is, after all, what is usually termed calorising). In this case a brittle coating of AlaFe was formed. Parts "alited" in this way are similarly said to have stood up well to the tests. There does not seem to be much that is new in this process, except perhaps the use of powdered ferro-aluminium instead of aluminium powder, and it hardly appears to justify the introduction of a new term in the already overwollen list of coating processes.

"Overreduced" Steel

Some exceedingly interesting conclusions emerge from investigations which have been carried out by the Bureau

of Standards, Washington, by J. V. McCrae, R. L. Dowdell, and L. Jordan, and published as Research Paper No. 250. They relate to the causes of a phenomenon known to steel foundrymen using electric steel, as "overreduction." It is seldom encountered in ordinary open hearth or Bessemer practice, although the converse condition, overoxidation, is often met with. Overreduced steels cause trouble in the foundry owing to their lack of fluidity, particularly when thin castings are to be made. The ordinary filming test in the ladle gives a much shorter count than a good casting steel should give, and not only is the fluidity lower, but there is greater shrinkage, more susceptibility to the effects of gases in the mould, and greater porosity in the resulting castings. Overreduction is attributed, in the case of acid steel made the electric furnace, to the presence of an excess of reducing agent, either silicon, or aluminium, but the former seems more harmful. The presence of such an excess, particularly in the case of silicon, seems at times to manifest itself by the increased emissivity of the surface of an overreduced steel, which may make the melter misjudge the casting temperature, and estimate it as higher than it really is. The tendency in an overoxidised steel seems to be for the oxygen to react to form silica, leaving an excess of silicon in the metal. This oxidises at the surface, thus reducing the "count," while the elongation and reduction of steels exhibiting this condition are likewise Details of analysis and tests on four acid electric charges, two of which were normal, and two of which were overreduced, are given in the paper

Metallurgists to Visit America

A detailed programme has been issued already for the visit that is to be paid to America next year by the Institute of Metals and the Iron and Steel Institute. These two international bodies have been invited by the American Institute of Mining and Metallurgical Engineers to hold their respective autumn meetings in New York in September, 1932, the meetings to be followed by a tour in U.S.A. and Canada, in the course of which many cities and industrial plants will be visited. The party, which is expected to number about one hundred European members, will leave Southampton on board a Cunarder on Saturday, September 3, 1932, and is due to arrive a week later in New York, there to be joined by a contingent of American members, expected to number about 200. After a week-end spent sight-seeing in New York, morning technical sessions will be held on September 12-13 in the Engineering Societies' Building, with local excursions to metal works each afternoon. September 14 will be devoted to an all-day trip to the works of the American Brass Company at Waterbury. On the following day the party will proceed to Bethlehem, Pa., visit the famous steel works, and then return to New York in readiness for a midnight start to Washington. Two days will be spent in the capital-with visits to the Bureau of Standards, Mount Vernon and other points of interest—and on September 17 Pittsburg will be reached. Here the week-end will be spent visiting the University, the Mellon Institute, the Carnegie Institute of Technology, steel works and aluminium works.

Strenuous Days in Detroit

Leaving Pittsburg early on September 20, most of the day will be spent visiting plants at Youngstown, followed by a night run to Detroit. Here three strenuous days will be passed. Members of the two visiting institutes will be able to take part in the visit to the Exposition and technical sessions arranged by the National Metal Association, then holding its annual Convention in Detroit, and a dinner will follow, given by the American Society for Steel Treating. They will also see some of the great motor plants at Detroit. On September 23 the Institutes' party leaves for Cleveland, where works' visits will be made during the afternoon, followed by departure for Chicago at midnight. Here the last weekend of the tour—now at its westward turning point—will be spent. Saturday, September 24, will be devoted to visits to steel and metal plants in the daytime, with a reception in the evening. The following day will be passed quietly, Niagara being reached the next morning. After a visit to the Falls and neighbouring works on September 26, the party will proceed to Hamilton and Toroato the next day. Many interesting visits will be paid in these two cities and also in Montreal and Quebec, whence the homeward bound liner will leave on September 30.

This programme represents the first combined trip ever arranged by the two Institutes, and is expected to prove very attractive. Already nearly 100 members have indicated their intention of travelling from European starting points, including Stockholm, Moscow, Prague, Berlin and Rome. The cost of the trip—estimated at the reasonable figure of £125—can be met in advance by means of an "instalment plan," in accordance with which intending participants pay £7 per month to the bankers of the Institute of Metals, interest being allowed upon their deposits, which are returnable in the event of non-participation. Full particulars of this plan and of the American trip generally, can be obtained on application to Mr. G. Shaw Scott, M.Sc., Secretary of the Institute of Metals, 36, Victoria Street, London, S.W.I. It is possible for eligible non-members to join either Institute in time to take part in the trip to America.

Size of Iron Ore Particles

In order to produce pig iron at economical rates, it is necessary to move large quantities of iron ore counter-current to large volumes of gases. The blast-furnace charge will settle smoothly provided the force of gravity exceeds the upward pressure of the gases and the support offered by the furnace walls, by an ample margin. Irregular-settling furnaces are inefficient. An investigation conducted by the North Central Station of the United States Bureau of Mines, Department of Commerce, in co-operation with the University of Minnesota, showed that under similar conditions of packing the resistance to gas flow varies inversely as the 1.2 power of the particle diameter. This means that 14-mesh particles offer about 40 times the resistance to gas flow as particles 1.05 inches in diameter. In beds of solids composed of sizes, ranging from particles 1.05 inches in diameter to 14-mesh, about 95 per cent. of the resistance is due to the particles between 0.371 inch in diameter and 14 mesh. At gas velocities attained in the blast furnace, much of the minus 14 mesh material offers little resistance to gas flow because it is in suspension in the effective interstitial area through which the gas is moving. Because of the high resistance which smaller sizes offer to gas flow, it is difficult to design and operate furnaces on lake ores so as to provide an opportunity for gassolid contact. In order to get furnaces operating on fine ores to settle regularly, gas distribution is sacrificed by establishing a relatively porous area in some section of the furnace through which sufficient gas may pass to avoid pressures that interfere with stock descent. Agglomeration of particles finer than 3 mesh would make a large difference in resistance.

Annealing of Aluminium Sheets

With the extraordinary growth in the industrial uses of aluminium, there has also been a very great advance in the methods of manufacturing the metal and its alloys to ensure high-grade products of known physical characteristics. Considerable interest attaches to new plant recently installed for the Aluminium Corporation, Ltd., at Dalgarrog, Carnarvonshire, which besides producing aluminium in ingot and bar form, has a modern and extensive mill capable of turning out every kind of sheet product.

To facilitate the very precise annealing of aluminium sheets on a large scale the General Electric Co. has recently installed for this firm a large single-track, multi-car type electric annealing surface which has an effective hearth area 24 ft. long by 7 ft. 5 in. wide. It has an electric loading of 150 kW the heating elements being arranged to ensure phasal balance on a 440 volt, 3-phase, 50 cycle supply. The correct disposition of heating elements in a furnace of this size is of primary importance. Composed of high-grade nickel-chromium alloy, the elements are placed on the side walls, in each section of the car hearth and also suspended from the roof. The doors at each end of the furnace are of the suspended counterweighted type, well insulated and sand-sealed both at the top and bottom. Special switches are provided which automatically switch off the current from the car hearth when the doors are raised and similarly switch on when they are closed. equipment comprises six cars or trolleys, on which the aluminium sheets are piled. There are four cars in the furnace at one time, and the two others are provided to facilitate cooling, loading and unloading.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

Although two months of the year have passed we are not yet in sight of the revival in the iron and steel trade for which we are so anxiously waiting. The state of trade has been no better during the month of February than it was before Christmas, and now that the extra weight of orders which accumulated during the holidays has been worked off, production is again falling owing to the lack of new business. Nothing has occurred in the financial, commercial or political world to offer encouragement for the near future. We have been given a grave warning of the sorry financial position of the nation by the Chancellor of the Exchequer, from which it appears inevitable that there will be an increase in some of the forms of taxation. The political situation seems to get more confused than ever. The three parties are at loggerheads, none of them being able to do anything really effective, and their activities are more of a hindrance than a help to the industrial life of the nation. Meanwhile the iron and steel industry, like many others, is struggling along in a depression which shows no signs of lifting. It is all very disheartening.

Steel Makers' Economies

The best efforts than can be put forth produce comparatively little result; and it is no use thinking, as some uninformed critics would have us believe, that the steel makers have not striven to their utmost to cope with the situation. They have explored every avenue to effect economies in production, without which it would have been impossible to carry on for so long, and it would be interesting if the full story were known of what has been achieved in this way. There are steel works to-day which, given an assurance of full or nearly full produc-There are steel works tion, would show a very satisfactory trading result, but that is hopeless with the present low outputs. Whatever success is attained in reducing costs is nullified by some further deteriora-tion in trade or by the increasing severity in the competition at home and from abroad. Only those who are in the industry know to what lengths price cutting is being practised. Fortunately nothing has yet upset the control exercised by the Steel Associations over the prices of steel plates and sections, but the numerous minor associations dealing with more or less special products are having the utmost difficulty in remaining in force, owing to the defections of first one, then another of their members.

As for the materials altogether uncontrolled, reason seems to have left the field, and it is impossible to foresee the limits to which some makers are prepared to go in cutting prices so as to secure orders over the heads of other makers. As we have pointed out on previous occasions, the double handicap of reduced output and reduced selling prices is putting a burden on the industry which cannot be borne much longer.

Effects of "Dumping"

The statements made by Lord Churchill at the annual meeting of the Great Western Railway on February 25 are worth noting, and they add weight to the demand for the adoption of the only means which is yet untried for reviving the iron and steel industry, the prevention of foreign dumping and the placing of our heavy industries in a position to meet foreign competition. Lord Churchill pointed out that out of 45 blast furnaces on the company's system, only five are in blast, yet pig iron is being dumped from abroad into South Wales at 2s. to 4s. per ton less than the South Wales prices; and it must not be forgotten that these home prices do not show any profit to the makers. A similar position obtains in regard to manufactured iron and steel goods. In South Wales alone the imports of these were 120,000 tons more in 1930 than in 1929, whilst exports have declined by over 200,000 tons.

Similar conditions exist in every other iron and steel centre. The direct results are familiar to everyone who knows anything about the industry, while the indirect results are equally tragic, in the decline in demand for coal, in railway traffic and in other services. This matter was also made the burden of the speeches at the annual meeting of the National Federation of

Iron and Steel Manufacturers in London about a fortnight ago. The President, Mr. A. J. Grant, pointed out that during 1927, 1928 and 1929 the volume of home production plus the retained imports of iron and steel provided a sufficient market to employ the industry practically at its full capacity, whereas we were only employed during that period to the extent of 65 per cent.; and that figure is much less now, probably nearer 30 per cent. It is necessary to reiterate these facts, because there seems to be no other way of forcing them on to the attention of those who have it in their power to make a change in our present fiscal system.

Regional Rationalisation

So far the only satisfaction it is possible to get is the statement made by the President of the Board of Trade that the Government are taking a hand in the reorganisation of the iron and steel industry. We know what that means. The Government is no doubt supporting the banks in applying pressure to the financially embarrassed undertakings to compel them to link up with others. Regional rationalisation it is called. Much good that will do while free imports are unchecked!

It would be a very unpleasant shock if it were known in what a difficult position are some of the combinations that have been carried through. Sir Peter Rylands, at the same meeting of the National Federation, spoke very forcibly on this subject. He said that politicians have seized upon the blessed word "rationalisation" as a cure for our industrial troubles, but we know very well that it is but an idle dream, and that "rationalisation under the conditions prevailing to-day can only mean concentrating on a narrower front and offers hope for little more than maintaining, perhaps precariously, our present position, and little or no prospect of improving it."

Monthly Trade Figures

The January export and import figures follow the unsatisfactory precedent set by December. The exports of iron and steel materials in January were 167,372 tons as against 169,544 tons in December, and less than half the tonnage reached in January last year. The imports were 60,000 tons less than in December, but the total of 221,773 tons still exceeds the exports. The home production figures also make a poor showing. There were seven furnaces less in blast at the end of January than at the beginning, and the output of pig iron fell from 349,800 tons in December to 337,200 tons in January. The output of steel increased slightly from 337,200 tons to 402,200 tons in January, but that was due to the weight of orders accumulated during the Christmas holidays.

Pig Iron Markets

The reports from the pig iron markets for the past month are not cheerful. In Cleveland business is restricted to the narrowest limits. The trade which the Cleveland makers have in Scotland is being seriously reduced by the imports of Indian iron at prices which cannot be met, and with the continued decrease in the export demand the furnaces are having to rely almost entirely on the local business. In the Midlands also there is little life in the market. Orders are few in number and small in weight, and stocks tend to increase. The position as regards steel, both semi-finished and finished, is equally unhappy. The demand for semi-finished steel has fallen off considerably, notwithstanding the very low quotations. Billets are being sold freely at £5 10s. to £5 15s. and the special qualities also are steadily falling in price. In finished steel the shortage of orders still continues, although in one or two works a slight improvement has been experienced owing to special orders which have been placed. For instance, the railway allocation of 19,000 tons of railway chairs has proved a welcome addition to the order books of the three North-East Coast works who are to make them. Prices of uncontrolled materials have still a downward tendency, although they are at a level which is definitely unremunerative to any maker.

Some Inventions of the Month By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Alloys

In making an aluminium alloy containing zinc and magnesium, with or without bismuth, a preliminary alloy of part of the aluminium with the zinc and magnesium is first prepared and this is added to the remainder of the aluminium, the bismuth, if any, being added last. In preparing the preliminary alloy successive small quantities of magnesium and zinc may be added alternately to some of the melted aluminium, followed by addition of more aluminium, and so on. 3-20 per cent. of a preliminary alloy containing 37 per cent. of aluminium, 17 per cent. of magnesium, and 46 per cent. of zinc, may be added in solid form to molten aluminium to make the final alloy. The bismuth content may be 0.5-5 per cent. See Specification 338,923, dated May 30, 1929, by H. J. Garrard of Sutton, Surrey.

Aluminium

To obtain aluminium a fused mixture of an aluminium halide with less than an equimolecular proportion of a halide of an alkali or alkaline earth metal is electrolysed, according to Specification 338,668 (Johnson), dated July 4, 1929, a communication from I.G. Farbenindustrie Akt.-Ges., of Frankforton-Main, Germany. Various compositions of electrolyte are specified. In one example a graphite anode and a rotating cylindrical cathode of graphite or metal are used. In another example the anode is of tungsten and the cathode is an iron roller arranged vertically in a frame with another roller pressed against it by springs: in this case the rollers are rotated slowly and the deposited aluminium is removed as a tube. Part of the electrolyte is removed continuously or periodically for purification and addition of aluminium halide.

Annealing Steel Alloys

ARTICLES of alloy steel which have been nitrogenised at 460-560° C. for 5-100 hrs. are reheated to a temperature between 590° C. and the lower critical temperature of the core material, preferably about 650° C. Such treatment serves to decrease the brittleness and increase the toughness of the case. The treatment of an alloy steel containing 0·32 per cent. of carbon, 0·56 per cent. of manganese, 0·18 per cent. each of silicon and molybdenum, 1·43 per cent. of chromium, and 1·3 per cent. of aluminium is referred to. See Specification 338,315, dated October 18, 1929, by R. Sergeson, of Massillon, Ohio, U.S.A.

Cast Iron

METHODS of annealing and case-hardening malleable cast iron are described in Specifications 338,924-5 (Burgess), dated May 31, 1929, communications from Link-Belt Co., of Chicago, U.S.A. 338,924. The iron is heated to a temperature at which the formation of iron carbide occurs (about 80° C.), cooled or quenched, heated to a temperature (about 65° C.) below the carbon combining temperature, and finally cooled or quenched. If the metal is to be galvanised by dipping the second temperature is above that used for galvanising. The first heating may be effected in presence of a carburising agent to provide a wear-resisting surface. The process is claimed. 338,925. The process of 338,924 is employed to obtain from malleabilised cast iron a granular ferrous metal or alloy with high resistance to abrasion and having about the individual grains a structure consisting mostly of iron carbide with greater resistance to abrasion than the main body of the metal. The product is claimed.

Iron and Iron Alloys

To obtain iron or its alloys with nickel or silicon in a carbon-free and oxygen-free condition carbon or oxygen is supplied to the metal in such quantity that these elements are present in substantially equal atomic proportions and the metal is melted with removal of the products of combustion as they are formed. Such removal may be effected by evacuation or by passage of an inert gas through the furnace. Carbon may be added as such, and oxygen as free oxygen, as air, or as an oxide of iron or of an alloying metal. The product may be allowed to solidify in a vacuum, and may be worked mechanically before cooling slowly from 900-1200° C. to

normal temperature. See Specification 338,409, bearing the International Convention date January 18, 1929, by Associated Electrical Industries, Ltd., of London, Assignees of T. D. Yensen, of Wilkinsburg, and N. A. Ziegler, of Edgewood, Pennsylvania, U.S.A.

Manganese Steel

To refine the grain-structure and improve the physical properties of manganese steel it is heated for 12-96 hours at 400-600° C., cooled slowly, reheated to about 1060° C., and quenched. Specified steels contain 11·5-13·9 per cent. of manganese, 1·13·1·29 per cent. of carbon, 0·54-0·84 per cent. of silicon, and 0·079-0·086 per cent. of phosphorus. See Specification 339,521 (Wade), dated December 31, 1929, a communication from Taylor-Wharton Iron and Steel Co., of High Bridge, New Jersey, U.S.A.

Treating Copper and Nickel Osire

In the treatment of ores or concentrates containing sulphides of copper and/or nickel or containing copper or nickel oxidized compounds together with added sulphur, e.g., in the form of iron sulphide, the material is subjected to the action of air or oxygen at 600° C., to produce the sulphates of copper and/or nickel, without any disturbance or rabbling of the charge during the reaction. In the subsequent leaching, the iron mainly remains in the residue as oxide. In the treatment of mattes containing copper, iron, and lead, lead sulphate formed remains in the residue, from which precious metals, if present, may be recovered by the known methods. See Specification 338,556, dated August 20, 1929, by E. A. Ashcroft of Ashburton, Devon.

Treatment of Zinc Ores

To extract volatile metals from a zinciferous ore containing sulphur, air heated to 650–800° C. is blown on to a thin travelling layer of the ore in two stages. In the first stage the air acts on the ore alone to remove sulphur and in the second stage it acts on the hot roasted product in admixture with reducing carbon. Apparatus comprising an inclined rotary drum through which the ore travels by gravity is described and illustrated. See Specification 337,636, bearing the International Convention date October 19, 1929, by A. Folliet and N. Sainderichin of Paris.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, but such total may have been reduced.]

JOPLING (E.) AND SONS, LTD., Sunderland, steel manufacturers.—Registered February 46, debenture, to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; charged on property at Pallion, also general charge. *£13,667. September 9, 1930.

TEMENGOR TIN MINING CO., LTD., London, E.C.—

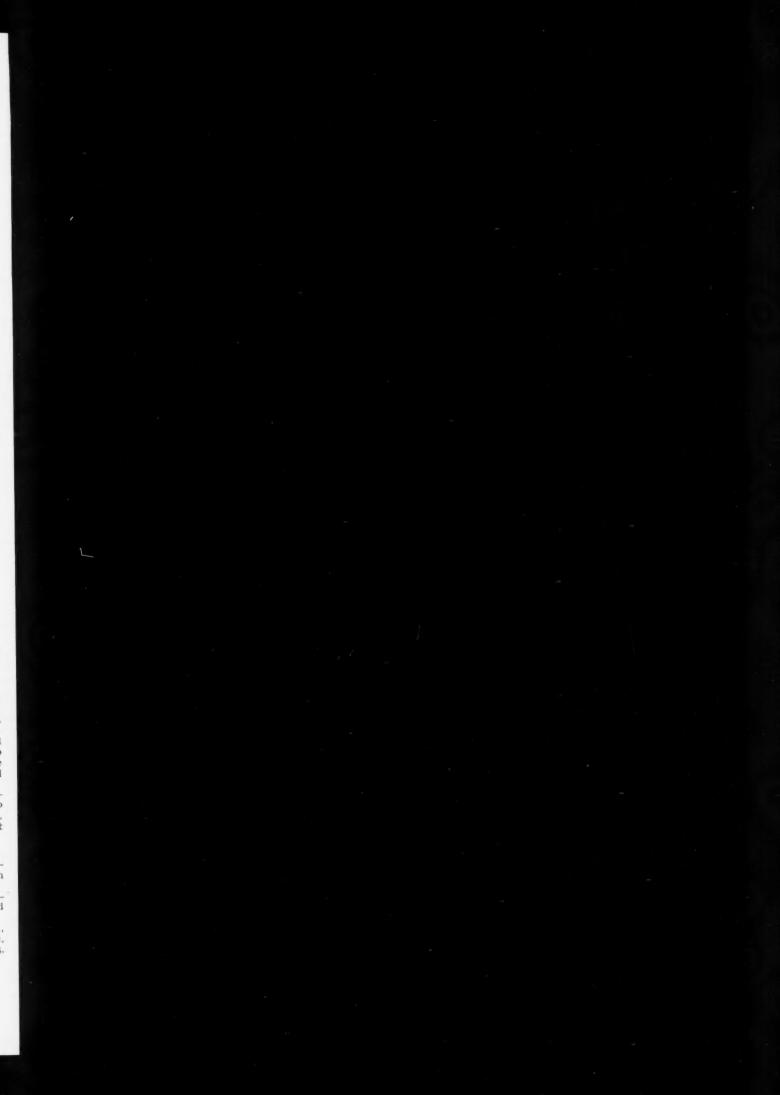
TEMENGOR TIN MINING CO., LTD., London, E.C.—Registered February 13, charge (supplemental to £50,000 debenture dated June 19, 1930), to A. Moncur and another, c/o, etc., 9, Gracechurch Street, E.C.; charged on land at Temengor, Upper Perak, F. M. S. *Nil. April 4, 1930.

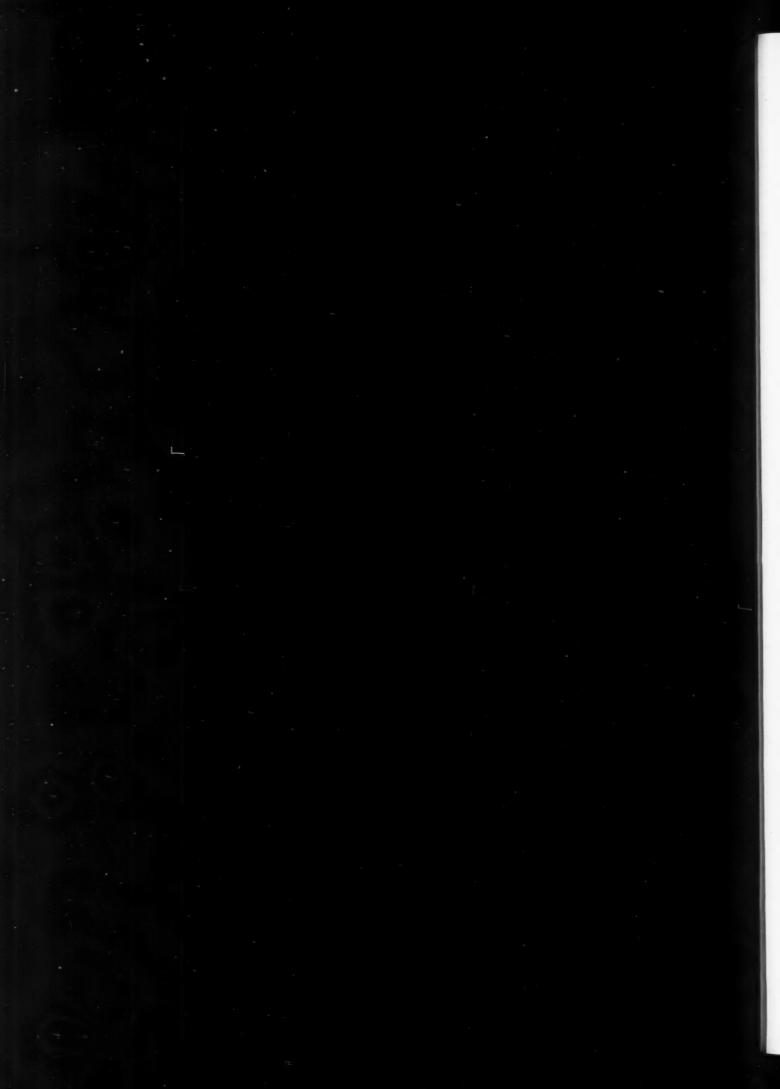
Satisfactions

BRITISH METAL (KINGSTON), LTD. (SURREY).—Satisfaction registered February 18, £3,500, registered March

NATIONAL SMELTING CO., LTD., London, E.C.—Satisfaction registered February 5, £1,500,000, etc., registered March 21, 1924.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington.—Satisfaction registered February 12, £8,950, part of amount registered February 10, 1922, March 25, 1927, and December 30, 1930.





NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor.

The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Deoxidation of Steel Use of New Manganese Silicon Alloys

The following extracts are from a paper by C. H. Herty and G. R. Fitterer, presented at the February meeting of the American Institute of Mining and Metallurgical Engineers. Both the authors belong to the U.S. Bureau of Mines, which has reprinted the paper as Report of Investigations 3,081.

Manufacturers and consumers of steel have come to realise during the past few years that cleanliness is of great importance in steels which must meet rigid specifications for various physical properties. Of equal importance is the consistent production of steel which is uniform in these properties. For maximum utility, steels should be uniform not only from heat to heat, but also from ingot to ingot and within each ingot. In the manufacture of killed steels such as the higher carbon forging grades, uniformity as indicated by the usual chemical analysis is easy to obtain, provided that a normal top discard is taken, as is always the case in steels poured with hot-top practice. No such uniformity, however, holds true for the non-metallic matter, which consists for the most part of the products of deavidation of the steel.

For a large tonnage of steels which go into articles manufactured by deep-drawing processes, killed steel has never been successfully applied because with the present deoxidation practice, low-carbon killed steel is almost invariably extremely dirty. To obtain the desired qualities for deep drawing, the steel is rimmed—that is to say, deoxidised with manganese and perhaps a small amount of aluminium—the resultant product being of high purity in the skin of the ingot, but very badly segregated at the centre of the ingot, particularly in the upper-central section. This segregation necessitates a very heavy top discard, and one of the major segregates is carbon which renders the steel too hard to draw properly. If clean, low-carbon killed steel could be made successfully, much better ingot yields would be obtained than by the present rimming steel practice. Furthermore, banded structures and outside and inside seams, which are undoubtedly due in a large measure to blowholes in the ingot, are defects which are very difficult to control in rimmed steel. These defects would be minimised by clean killed steel.

A perfectly deoxidised steel would be one in which the FeO (and whatever CO may be present) has been completely removed and which would not contain any products of deoxidation. That this theoretical deoxidation practice could ever be attained is quite doubtful, and just what the physical properties of such a perfectly deoxidised steel would be is unknown. However, it is the effort of the present-day steel-maker, in making steels which require high-tensile, impact, and fatigue strengths, to arrive at a compromise between the two limits set forth above—that is, no FeO (or CO) left in the steel, also no products of deoxidation. The amount of FeO (and CO) which can be removed from the steel is proportional to the amount and strength of the deoxidiser or deoxidisers used, and the percentage elimination of the deoxidation products is governed by a number of factors which are discussed later.

During the past five years the United States Bureau of Mines, in co-operation with Carnegie Institute of Technology and the Metallurgical Advisory Board, has been engaged in a study of the physical chemistry of steel-making. One of the most important phases of this investigation has been the deoxidation of steel. At the outset of this work it was decided to make a comprehensive study of deoxidation with the three deoxidisers commonly used—manganese, silicon and aluminium. The procedure outlined was to study each deoxidiser separately, then study deoxidation with binary alloys, and finally with ternary alloys. Obviously, wide ranges of com-

position are available in both the binary and the ternary alloys.

Present Use of Deoxidisers

In current steel-making practice it is customary to use manganese and silicon, and in some cases aluminium and other strong deoxidisers such as titanium, zirconium, etc., to produce a dead-killed steel as free as possible from non-metallic inclusions. In most dead-killed steels some non-metallic inclusions are left in the steel because (I) sufficient time has not been allowed for the particle to be eliminated; and (2) it is highly probable that a great many particles are of a colloidal nature, and no matter how long the steel is allowed to stand they cannot be eliminated. For forging grade steels the current practice is to add silicon and manganese in the furnace in various ways and complete the deoxidation with silicon in the ladle. The silicon addition in the furnace is used to prevent the elimination of carbon while the laboratory checks the heat analysis before the heat is tapped. Sometimes other strong deoxidisers are added in the ladle. In some instances, complex alloys such as aluminium-silicon alloys, aluminium-silicon-titanium alloys, and others have been used in the furnace.

Before entering into a discussion of the experimental work involved, it will be well to set down the conditions that will prevail for the most rapid elimination of non-metallic inclusions from the steel bath. The factors which affect the rate of elimination of these inclusions are size of the particle, difference in density between the particle and the steel bath, and the viscosity of the steel.

Formation of Iron-Manganese Silicates in Steel

Three different methods of deoxidation may be employed to obtain inclusions consisting of iron oxide, manganese oxide and silica, as follows:—

Deoxidation with Manganese followed by a Silicon Addition:—
If manganese is added to steel containing FeO, MnO is formed. The FeO that remains after such an addition, and a portion of the MnO, will be dissolved in the liquid steel. Any insoluble oxides resulting from this deoxidation would exist in the binary system FeO-MnO described above. Now, if a silicon addition is made, silica particles are formed which will immediately tend to come to equilibrium with the surrounding metal by fluxing the dissolved FeO and MnO and any insoluble binary oxides. Hence, by varying the manganese and silicon additions, various ferrous-manganous silicates can be formed. If the proper additions could be made, it is possible that a fluid inclusion particle could be obtained which would flux with its kind to form large particles, which in turn would be rapidly eliminated from the metal.

Deoxidation with Silicon followed by a Manganese Addition:—
If various amounts of silicon were added to a steel containing a known amount of FeO, to deoxidise the steel partly or completely, inclusions would be obtained which exist in the FeO-SiO₂ slag system. However, if at this time sufficient FeO still remains in the steel so that some MnO could be formed by means of a manganese addition, some ternary oxide combinations might also be formed. It is quite evident, however, that much difficulty would be encountered in attempting to form large fluid inclusions from this type of double deoxidation, because silicon is such a strong deoxidiser

that there would be little FeO left for reaction with manganese, unless sufficient FeO had diffused from the slag into the metal to make the manganese-iron oxide reaction possible.

Deoxidation with Manganese-Silicon Alloys:—If steel were completely deoxidised with any manganese-silicon alloy, inclusions would be formed which exist in the binary system MnO-SiO₂. If the steels were only partly deoxidised with such alloys, some FeO would remain dissolved in the steel which would flux with the manganous silicate in such a manner as to form the ferrous-manganous silicate which has the desired composition and fluidity to form large inclusions. By the foregoing three methods the oxide combinations existing in the ternary system FeO-MnO-SiO₂ may be approached from any binary slag system. The last method is outstanding in its possibilities.

Discussion of Results

The major object of this series of investigations was to find a deoxidising material which would thoroughly deoxidise the steel bath and in this deoxidation would form reaction products which were fusible at steel-making temperatures and which would coalesce with one another to form very large inclusions with a resultant quick cleaning of the metal. Some of the manganese-silicon alloys fill the functions of such a deoxidising material.

In previous investigations on deoxidation with silicon, the average size of the particles formed in the killed steels was approximately 15 cm. × 10-4. It was found that in one dead-killed ingot, the largest particles were about this same size, indicating that there was a great deal more silica formed than manganese oxide. This conclusion was confirmed when the metal was analysed for MnO and SiO₂. As the amount of manganese in the alloys increased, the size of the inclusions formed increased also, and in the dead-killed steels the largest inclusions were found in steels deoxidised with the alloy having a ratio of manganese to silicon of 4·18. It was impossible to kill the metal with the alloy having a ratio of manganese to silicon of 8·70 without going to excessively high amounts of manganese added. These data indicate that the most favourable alloy for dead-killed steel would have a ratio of manganese to silicon of at least 4·18, and probably slightly higher.

Formation of Large Inclusions

The mechanism of formation of these large particles involves several important factors: upon the addition of a manganesessilicon alloy it must first dissolve in the steel and then manganese and silicon can react with FeO to form MnO and SiO2. The SiO2 is insoluble in liquid steel and innumerable small globules are formed; MnO, on the other hand, is appreciably soluble and no MnO particles will form unless the saturation has been exceeded, which is unlikely in most practical steels. At this point, each silica particle is surrounded with steel containing MnO and possibly a small amount of FeO. Hence the metal and silica particle tend to establish an equilibrium which is very similar to that of acid open-hearth practice. In other words, the SiO2 absorbs some MnO (and FeO) from the metal phase to form a slag phase of manganous silicate (containing some FeO).

As this absorption proceeds, the silicate slag particle not only increases in size but also becomes more fusible and fluid. For this reason, collision between like particles is more likely to insure coalescence than if the particles were composed of pure SiO₂, which is solid at steel-making temperatures. Hence large inclusions are formed by means of these two processes, namely, the absorption of MnO by SiO₂ from the surrounding metal and the accidental collision of the silicate particles. Also, evidence has been found which indicates that these fluid particles are attracted very strongly to one another by their surface-tension relations.

Rate of Rise of Particles

A particle 1,000 microns (cm. × 10⁻⁴) in diameter will rise through steel 1,000 times as fast as a particle 10 microns in diameter, and with the necessary velocities certain particles would rise out of the bath almost as soon as they were formed. Particles 100 divisions or larger formed on deoxidation would probably be eliminated from the open-hearth bath before a sample could be taken. It has often been noted in sampling large heats deoxidised with alloys of the composition used in this work that samples taken 3 minutes after the addition

contained only a small amount of non-metallic matter, even though the steel was highly oxidised before the addition. In tests taken immediately after the addition, manganese silicates were found in the top of the small test samples. The importance of holding the ladle is also shown in that large inclusions would most certainly be completely eliminated from the metal if the ladle were held for 20 minutes. If the ladle were held for 5 or 10 minutes, these large inclusions would be well on their way toward the slag-metal inter-face, and by the time that teeming was completed they would probably have been eliminated from the steel. On the other hand, if very small particles were formed on deoxidation, such as is generally the case in deoxidation with silicon alone, holding the ladle would be of much less value.

Molybdenum in Foundry Practice Improvements in Cast Iron and Malleable Iron

Some notes on the properties imparted to cast iron and malleable iron by the addition of molybdenum are outlined in a recent publication issued by High Speed Steel Alloys, Ltd., of Widnes, Lancs. In the case of grey cast iron a transverse strength of nearly 5,000 lb. per sq. in. is obtainable by the addition of 0.4 per cent. molybdenum to iron containing 1-65 per cent. silicon and 3-0 per cent. carbon, in comparison with a maximum transverse strength of about 3,200 lb. per in. without the addition of molybdenum. In the case of malleable iron, two points are noticeable: First, the most prolonged heat treatment, highest tensile strength and elongation can be obtained by adding molybdenum, otherwise not possible without its addition; secondly, by the use of molybdenum, the time required for heat treatment may be reduced by 75 per cent. to obtain a product equal to malleable iron of normal composition. These and other advantages, such as improved machinability, extend the possibility of utilising malleable iron over a wider field than at present. The additional cost of molybdenum in cast iron is about 10s. per ton of iron in the ladle for each o r per cent. of molybdenum, and the maximum quantity required for the most intensive results should not exceed o.7 per cent., or in cost, 70s. per ton.

The properties given to grey cast iron by the addition of molybdenum are summarised as follows: (a) It breaks up the large graphitic carbon flakes and distributes the graphite carbon more uniformly in small flakes; (b) it produces smaller grains in the structure; (c) as the result of the foregoing, it increases the transverse and tensile strength; (d) it produces a slight increase in hardness of medium and heavy sections as measured by Brinell; (e) it produces a narrower spread of hardness in castings which have wide variations of thickness; f) it tends to combat white iron edges, although large quantities of rusty scrap in the cupola charge, melting at too low a temperature, pouring at the wrong temperature, and wet sand, may produce white iron edges in spite of molybdenum additions; (g) it gives better machinability in properly made castings, attributed to the more uniform distribution of the lubricating graphite carbon; (h) it produces a smoother machined surface; and (j) it tends strongly to reduce the number of foundry hot cracks. Improvements effected by the addition of molybdenum to malleable iron are chiefly the production of a smaller grain size with a tendency for a physical interlocking of the grains, in consequence of which there is considerable improvement in the wearing resistance of brake drums and chains made from such malleable irons.

There are no great difficulties to be met with in making cast iron containing molybdenum. Despite its high meltingpoint, molybdenum dissolves in molten iron at a temperature far below the normal melting point of molybdenum itself. It is, therefore, unnecessary to heat the iron to a higher temperature than is normally employed in foundry practice even when preparing an alloy containg the maximum amount of molybdenum necessary for any purpose in cast iron. For large castings, or a number of castings made at the same time, ferro-molybdenum, calcium molybdate, or molyte may be employed, well mixed with the cold charge passed to the furnace or cupola. In this way 95 per cent. of the molybdenum added can be evenly distributed throughout the iron. For small castings, the addition of the molybdenum can be made in the ladle; here ferro-molybdenum is employed, broken to \$\frac{1}{4}\$ in. mesh size, and as dust, to ensure rapid solution in the iron.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Dr. Walter Rosenhain

THE resignation of Dr. Walter Rosenhain, F.R.S., Superintendent of the Department of Metallurgy and Metallurgical Chemistry at the National Physical Laboratory, Teddington, will have effect in June next, and he is understood to be taking up consulting work. He has done a very considerable amount for the advancement of his branch of science in this country, and his Department now has one of the most famous laboratories of its kind in the world. He possesses a delightful manner of public speaking, quietly confident, and dealing with abstruse subjects as though they were the most human in the world. He has written a standard work on physical chemistry and has originated some great advances in metallographic technique. Among his other distinctions Dr. Rosenhain is a Bessemer Medallist of the Iron and Steel Institute, a past president and Fellow of the Institute of Metals, and a member of the Council of both the Cast Iron and Non-Ferrous Metals Research Associations. He was a prime mover in establishing the new International Association for Testing

Co-ordinating Research Another of Dr. Rosenhain's interests is the charge of the movement now on foot for bringing about international collaboration in metallurgical research to end the present deplorable overlapping that takes place in many fields. the result of an informal meeting between representative metallurgists from France, Germany and Great Britain in London a year ago, it was decided to hold a further conference in Dusseldorf in September last. Owing, however, to delays and lack of the necessary organisation, the conference has been postponed until next September, and it is felt that all countries interested in metallurgical research must be represented. The Congress of the International Testing Association will be held in Zurich at the same time as this conference, and the autumn meeting of the Institute of Metals will follow in the second week of the month, also at Zurich. It is suggested that the metallurgical societies in each country should prepare an annual or bi-annual report outlining the metallurgical research papers that have been published. These reports are then to be submitted to an international co-ordinating committee which will examine them to eliminate contradictory claims and statements and enable the workers of each country to recognise and use the results obtained by workers elsewhere and avoid duplicating their efforts. Almost all countries have agreed to send representatives.

Papers of Antiquarian Interest

THE first paper down for reading at the annual meeting of the Institute of Metals, held recently, was of antiquarian, rather than of direct scientific interest, and dealt with the subject of the corrosion of early Chinese bronzes. Many of the bronzes investigated had been buried and the corrosive influences to which they had been subjected were, as a result, sufficiently complex to render any very definite conclusions respecting them difficult to draw. On the other hand, a good deal of interest attaches to the descriptions of the corrosion products amongst which mineralisation had, to a considerable extent, occurred, the resulting minerals corresponding with many of those commonly met with in copper and tin ore deposits. A useful and comprehensive list of analyses of specimens ranging from 3,000 years old down to within the first two centuries of the Christian Era is given by the author, Captain W. F. Collins, and some very early testimony is cited, from ancient Chinese records, of the composition of various bronzes intended for different purposes. gave rise to an interesting discussion.

Extrusion of Metals

THE paper which elicited the best discussion, in which, however, the opinions expressed were not always in agreement with the conclusions arrived at by the authors, was one on "The Influence of Pressure and Temperature on the Extrusion of Metals," by Mr. C. E. Pearson and Dr. J. A. Smythe. It may be described as a practical paper, but the scale upon which the experiments it describes were made

and the press employed were both too small for the findings to be applied directly to practice with comparatively large ingots. The metals employed were lead, cadmium, bismuth and tin. Extrusion both by direct, and by inverted methods, were described, and the paper commences with a review of the work of previous investigators, while, incidentally, the authors deal likewise with the nature and causes of certain defects which occur in extruded rods. High-purity metals were employed in the experiments ("Chemilead," 99-99 per cent. pure; bismuth, 99.9 per cent. pure; copper-free tin, and cadmium contaminated only by very small traces of other metals). Naturally, the influence of temperature and the pressure was found to vary according to the particular metal being extruded, and is duscussed separately in each section of the paper. Another section deals with the effect of lubrication in direct extrusion. This aspect, too, of extrusion practice, raised a good discussion.

Behaviour of Extruded Bismuth

Perhaps the most interesting result described in the paper is the effect of extrusion on the properties of the normally very brittle metal, bismuth. This, the authors describe as being readily capable of being extruded over a considerable range of temperature. Thus, between 30° C. and 250° C., bismuth was extruded in the form of smooth rods which had considerable strength and could be bent through an angle of 180° without fracture. Above 250° C., however, what the authors describe as segmentation took place and the metal became so weak that it could no longer be extruded. The segmentation appears to be due to a longitudinal stress set up, during extrusion, in the outler layer of the rod by the restraining action at the sides of the die. When the metal is weak, as at high temperatures, or incapable of further deformation to relieve this stress (as in bismuth at a low temperature), surface cracking ensues. The observations relative to the ductility of extruded bismuth are not, of course, new, an I the authors themselves cite the earlier work of Spring and of Tammann, on this subject. The former extruded thin rods of bismuth, the ductility of which was such that they could be tied into knots, while Tammann put the plasticity of bismuth, as determined by extrusion, between that of cadmium and that of tin, a position, in the ductility scale which is borne out in the paper referred to.

Dimensional Stability of Aluminium Alloys

In these days, when many engineering tolerances have to be exceedingly small and dimensional permanence is a very important consideration, any changes due to ageing, such as those undergone by some of the aluminium and magnesium alloys, need close investigation. The paper by Mr. J. D. Grogan and Mr. D. Clayton on "Dimensional Stability of Heat-Treated Aluminium Alloys," read and discussed at the Institute of Metal meeting, deals, therefore, with a subject of direct practical importance. Cast and wrought Y-alloy, wrought duralumin, and 2L5-alloy, both chill and sand cast, were employed, heat-treatment being applied in some instances, but not in others. No secular changes were detected in heat-treated aluminium alloys after the normal age-hardening process had been completed, but considerable dimensional changes occur when material quenched in cold water is subsequently machined. They were found to be greatest in Y-alloy, less in duralumin, and least of all in copper-silicon alloy. The changes differ in different directions, being, in the case of a heat-treated cylinder, less along the central length than along the peripheral length, when concentric rings are machined from the middle portions; hence the ends become convex. These dimensional changes and others met with in the course of the experiments described in the paper do not appear in annealed material. The work, which was carried out at the National Physical Laboratory, is of the careful and suggestive nature members of the Institute have learned to expect from investigators attached to the Department, and the reading of the paper was followed by a brisk discussion on the causes of such dimensional changes as are recorded in connection with the alloys dealt with.

Influence of Antimony and Arsenic on Copper

S. L. Archbutt, and W. E. Prytherch have published a further instalment of the long and elaborate series of investigations which have, for some years past, been conducted at gations which have, for some years past, been conducted at the National Physical Laboratory, on the effects of impurities on copper. The present research, which is divided into two parts, deals with the effect of antimony, by itself, and of antimony and arsenic together, on copper. All the needful precautions were observed to ensure the use of high purity materials in the preparation of the series of alloys investigated, and the following is a brief résumé of the conclusions arrived at: Alloys containing up to 0.47 per cent. of antimony can be hot-rolled, and, after annealing, can withstand further reduction in the cold. With o.85 per cent. of antimony the alloy was hot-short. On the other hand such an alloy, in small billets and cold-rolled to $\frac{5}{8}$ in. diameter rod, offers no difficulty, while with smaller amounts of antimony such rods can be flattened cold, by hammering, or further cold-rolled to 0.05 in. strip. The tensile strength is improved, without detriment to ductility; electrical conductivity is considerably reduced, but not as much as when arsenic is present. It is essential that these conclusions should be considered subject to there being no oxygen present. In the case of both antimony and arsenic being present, hot-rolling appears to be facilitated, and the tensile strength is likewise improved. Together, these constituents raise the softening temperature to a greater extent than when arsenic alone is present. again, the proviso is that less than 0.02 per cent. of oxygen is present in the alloys. Generally speaking, the effect of antimony is similar to, but more pronounced than, that of arsenic, but these two metals, in conjunction, confer superior properties on copper, particularly at high temperatures and in annealed material.

Light Metals and their Alloys

The new Italian periodical, Metalli Leggeri e loro Applicazioni (Light Metals and their Applications), of which the first (double) number has just appeared, is a notable accession to the rapidly increasing periodical literature devoted to the non-ferrous metals. Tin, brass, aluminium and nickel all have their separate journals, and zinc had, until recently, its own organ in the United States. Metalli Leggeri is edited by Dr. A. W. Bonaretti, who, in the issue referred to, contributes an exhaustive introductory article on the production and application of light metals and alloys in Italy, as well as a valuable study of the influence of antimony in aluminium alloys. Another of the principal articles is by Dr. F. Libera, and deals with aluminium alloys. The remainder of the issue, dated January-February, is devoted to news items, statistics, prices and tariff information, and notices of meetings, amongst which prominence is naturally given to the important International Foundry Congress to be held in Milan, from September 12 to September 16. An exhibition of materials and foundry equipment is to be held in Milan concurrently with the Congress, after which a tour has been arranged which will enable sessions to be held, for the reading and discussion of papers, in Turin, Genoa and Rome, in each of which cities a programme of visits to works has also been arranged. At the end of the journal is an appendix which gives a synopsis and a first instalment of a very comprehensive series of articles which will deal in future issues with aluminium, magnesium, beryllium and their alloys

Elektron and its Congeners

The publication of this new Italian journal may be taken as one of the many indications of a new and intensive phase of activity in regard to the light metals and their alloys generally. Hitherto, one of the potentially most important of them, magnesium, has failed to attain the industrial prominence anticipated, while the world still awaits a supply of cheap beryllium adequate to the due development of a whole range of alloys which may be expected to open out a new era in engineering applications. There are, however, many signs that magnesium and magnesium alloys are about to come into their own. Thus, at the annual general meeting of James Booth and Co. (1915), Ltd., held in Birmingham on March 19, the chairman, Mr. C. Herbert Smith, foreshadowed developments in the production of elektron, for which the firm has

obtained the sole rights in the United Kingdom, and in the wider application of this alloy, or rather, range of alloys, for, like duralumin, in the production and application of which this firm was the pioneer in this country, elektron is made in several grades and compositions. This alloy, which has been made the subject of several papers read before scientific societies, can be cast, rolled, or extruded. It withstands corrosion well, and with further research will doubtless be made to withstand such influences better, the corrosion problem having been the chief difficulty, hitherto, to the greatly extended uses of a peculiarly valuable range of materials.

Nickel Production

Largely as the result of researches instituted by the nickel producing companies to find new uses for the metal, there has been a very marked increase in its production for the motor industry, cooking utensils, submarine cables and various nickel alloys. Although the volume consumed in 1930 declined with that of other raw materials, there was a growth in the diversity of its applications, and one of the features of the year was the rapid increase in the use of corrosion resistant steel of the nickel chromium type. In Canada, which produces 90 per cent. of the world's supply, and the United States, consumption for the production of alloy steels, the backbone of the nickel industry, fell off substantially during 1930 because of the radical curtailment in the production of motors. This decline was partly offset, however, by an increase in the use of nickel steels by manufacturers of machinery for glassworking, sugar refining, road-building, mining, textile manufacturing and similar purposes. The use of nickel with cast iron, after some recession during the earlier part of the year, reached its 1929 level in the last quarter of 1930.

Applications of Nickel and Nickel Alloys

A concise vésumé of the modern applications of nickel and alloys in which nickel is an essential constituent, are outlined in a recent publication of the Information Bureau of The Mond Nickel Co., Ltd. In this publication the more important properties of these materials are chiefly discussed, together with the uses to which the various alloys are put. Respective sections of the publication deal with malleable nickel, nickel-plating, nickel-copper alloys, nickel brasses and bronzes, nickel iron alloys, nickel alloy (constructional) steels, corrosionand heat-resisting steels and alloys, nickel in light aluminium alloys, nickel cast iron, nickel as a catalyst, nickel-alkaline storage batteries, and nickel coinage.

Copies may be obtained on application to The Bureau of Information on Nickel, The Mond Nickel Co., Ltd., Imperial Chemical House, Millbank, London, S.W.I, mentioning Publication H.6.

Cadmium in Bearing Metals

The use of cadmium in bearing metals promises to increase the world's production of this metal. It has been found that an alloy containing cadmium 96·7 per cent., copper 3·1 per cent. and magnesium 0·2 per cent. has outstanding qualities for this purpose. Compared with the usual tin-base metals it is harder; has a higher melting point, and has also a lower coefficient of friction. The National Physical Laboratory has made a series of tests on this alloy, reporting most favourably on the results. The alloy was cast into bearings and tested in a specially designed machine under loads ranging from 500 lb. to 2,500 lb. per projected sq. in. At all loads up to 2,000 lb. per sq. in. and with a peripheral journal speed of about 11 ft. per second, the bearing remained in perfect condition, no scratches being produced. In commenting upon these tests, the Director of the National Physical Laboratory stated that under severe loading conditions the cadmium-copper alloy proved to be equal to the best phosphor-bronze bushes which had been tested in the machine and which generally show signs of distortion at 2,500 lb. per sq. in. Tin-base white metals tested in the same machine had rarely carried more than 500 lb. pressure per sq. in. without distortion or flow.

In 1913 the world's production of cadmium was only 60 tons; it has now reached a total of 1,500 tons per annum, a very considerable proportion of which is used for the protection of iron and steel by electro-deposition or by spraying.

Trade, Commerce, Finance: The Month in Review From Our Market Correspondent

Whatever hopes one may have had at the beginning of the year for a revival in the iron and steel trade, the first quarter which has just ended has signally failed to realise them. There has been, and still is, some talk of a better tone in the market, but it has not been impressive. As usual, business has tapered off somewhat on the approach of the holidays, and the stoppage in most works will be at least as long as in previous years. Then, when that interruption is out of the way, we shall be within a few days of the Budget, and it is not likely that there will be any business activity until it is known what the Chancellor of the Exchequer proposes to do.

Selling Price of Steel

A survey of the past quarter is by no means encouraging. Let us look first of all at the selling prices for steel. In controlled materials, that is to say plates, sections and joists, there has been an increase in the rebate which is equivalent to a reduction of 5s. per ton in the selling price. In uncontrolled materials, which include billets, small bars, sheets and boiler plates, internal and foreign competition has reached limits not previously heard of since the war. Soft billets are being sold at about £5 10s., small steel bars at about £7, sheets under ½ in. thick at £9, and boiler plates at £8 17s. 6d., all delivered into consumers' works. These prices are for British steel. Continental prices are on the average about £2 per ton below ours, so that it is obvious that the reductions have not been made for the purpose of competing with foreign steel. They are simply the outcome of the rivalry amongst British steel makers, each of whom has been and is still trying to outbid the others for what business is available, and all of them are losing more or less heavily in the process. At the same time it has to be confessed that the object which in any way justifies such drastic price cutting, that is to say, a marked increase in production, has not been achieved. The fall in prices has been accompanied by the exceptionally low level of production which has persisted since last year. The output for the three months is little more than half of what it was for the same period in 1930. This has given the steel makers no chance to cheapen production by reducing overhead charges.

Lower Prices for Raw Materials

There has certainly been some advantages in lower prices for raw materials. Scrap has come down to the lowest price it has touched for about 40 years. Coal and coke are also comparatively very cheap, although under the influence of the Coal Mines Act, which is creating an artificial shortage in certain districts, the advantage of cheap fuel is likely to be reduced. Pig iron and hematite have also fallen very considerably. Yet all these benefits have been swallowed up in the increased cost which inevitably follows small outputs. The position, therefore, with short production and low selling prices, is doubly serious. It is no wonder that the financial results which are now beginning to appear in the papers are so unsatisfactory. In several instances recently losses have had to be reported, and it will be a hard problem for many of the other steel works to avoid doing the same.

Effect of a Poor Start

The market condition in the first quarter of the year has, in the past, proved to be a fair indication of the probable course of trade during the remaining months of the year. A brisk upward movement in the New Year has usually furnished an impetus which has carried the trade through to the end of the year, apart, that is, from abnormal circumstances. In the same way, a state of depression at the commencement of the year takes a long time to disappear. It will be remembered that the downward turn of trade set in at the beginning of 1930, and has not yet changed. Only some outstanding event can effect the desired revival this year, and there is nothing of that kind to which one can look apart from a change in the Government or, alternatively, the adoption of protection, or

safeguarding, for the iron and steel trade, by the present Government.

Control in Industry

If protection is to be given to the industry, it ought not to be hampered by conditions which will result in legislative interference. The newspapers have already foreshadowed the possibility of this, the suggestion being that a system of tariffs may be introduced on the condition that rationalisation and reorganisation within the industry are pushed forward under parliamentary authority. It may be, however, that the repeated official talk about intensive schemes of rationalisation is more of a threat than a definite policy, and it can be safely left to the banks to do all that is necessary in applying pressure on those undertakings which are not "pulling their weight." Meanwhile the process of cutting out redundant plant is being actively pursued. The English Steel Corporation have taken a further step in shutting down the carriage and wagon works at Nottingham. This follows on the dismantling of the steel works at Penistone, and although in both cases serious hardship will be inflicted on the work-people in the two districts, it has to be borne in mind that both were after-war plants for which the need no longer exists and they should be the first to go. If the long view had been taken earlier on, some of the other steel plants which are of recent growth might well have been shelved.

Recent Trade

Reports from the pig iron centres do not make cheerful reading. The Cleveland makers are finding both the export and the home trade very dull, and they are suffering not a little from the competition of Continental and Indian iron. In the Midlands, too, there is no improvement in the demand. Prices have so far been maintained, although consumers are suggesting that the time has come for a further reduction. In the steel trade, lack of orders is still the general complaint, and it affects every class of steel. There have recently been some good orders given out by the railway companies for steel rails and sleepers, but these are limited to a few works and do not appreciably affect the general position.

The production figures for February are not too good. Pig iron fell to 320,200 tons, compared with 337,200 tons in the previous month, and there was a decrease of two in the number of furnaces in blast. The output of steel was 486,400 tons, compared with 402,200 tons in January, but the low January figures were due in some measure to the holiday stoppage.

Lead and Zinc in Canada

The large annual increase in the Canadian production of lead and zinc during the last few years has been mainly due to the successful development of the Sullivan mine of the Consolidated Mining and Smelting Company of Canada, at Kimberley, British Columbia. The production of lead in 1929 amounted to 163,000 tons, being about nine per cent. of the world output, and it is estimated that the production for 1930 was approximately 170,000 tons. In the case of zinc in 1929 the production amounted to 98,634 tons or six per cent. of the world output and the estimated production for 1930 was 135,000 tons. British Columbia has been all along the main source of lead production, although substantial contributions have been made from Quebec, Ontario, and in recent years from the Yukon Territory. Since 1905 British Columbia has been the main source of supply of zinc in Canada. As the ore from this province had to be exported under difficult conditions, no large production was recorded in Canada until early in 1916 when the electrolytic zinc refinery at Trail started to produce refined zinc on a commercial scale. Gradual improvements in treating methods and the building up of an export trade have enabled Canadian zinc production to increase very rapidly. Additional production of lead and zinc is anticipated from important discoveries in various parts of the Dominion as soon as market conditions improve.

Some Inventions of the Month By Our Patents Correspondent

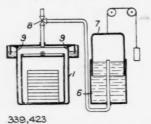
Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in The CHEMICAL AGE.

Allove

An alloy for use in die-casting described in Specification 340,104, bearing the International Convention date June 5, 1929, by New Jersey Zinc Co. of New York, consists of zinc of about 99.99 per cent. purity together with 2—10 per cent. of aluminium, 0.01—0.3 per cent. of magnesium, and not more than about 0.01 per cent. of lead +cadmium. The contents of cadmium, lead, and tin are preferably not more than 0.003, 0.003, and 0.001 per cent. respectively.

Annealing Metals

To control the pressure of the inert gas in the cooling container 1 of a bright-annealing apparatus, the container is connected to a gasholder 6 of which the bell 7 has a range sufficient to allow for the initial expansion of the gas and its subsequent contraction during the cooling. The container is provided with a liquid-sealed cover, and communicates with the sealing



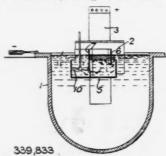
space through holes 9 above the liquid level. A three-way cock 8 serves to control the connections with the container 1, the holder 6 and the atmosphere, and a single holder may be in communication with several containers. See Specification 339,423, bearing the International Convention date October 22, 1928, by Siemens-Schuckertwerke Akt.-Ges. of Berlin.

Electrolytic Deposition of Metals

To adapt an aluminium surface to receive an electrolytic deposit of another metal it is subjected to a preliminary electrolytic deposition of an amalgam. In an example an aluminium article is cleaned, pickled and electroplated for a few minutes at 1.5 volts in a preliminary bath containing 200 gms. of caustic soda, 200 gms. of sodamide, 40 gms. of stannous chloride, 10 gms. of zinc chloride, 5 gms. of mercuric nitrate, and 10 gms. of pure potassium hydroxide in 20 litres of water. It is then rinsed and plated, e.g., with nickel, copper, gold, or silver. See Specification 339,339, dated September 3, 1929, by M. K. De Trairup of London.

Electrolytic Furnaces

In an electrolytic furnace described in Specification 339,833 (Arnold), dated January 11, 1930, a communication from Dow Chemical Co. of Midland, Michigan, U.S.A., the surface portion



only of the electrolyte is circulated through a trap in which the metal is collected. The metal collects between baffles 6, 7, carried by the trap 5. The carbon or graphite anode 3 is surrounded by a porcelain or fireclay member 2, and the trap 5 is disposed between this member and the iron container 1 constituting the cathode. The trap is fitted with a submerged propellor 10.

Magnesian

In a process for obtaining magnesium by electrolysis of fused magnesium chloride the chlorine produced is converted into hydrochloric acid which by reaction with a magnesian limestone such as dolomite provides a mixed solution of magnesium and calcium chlorides from which the magnesium chloride is separated, dehydrated, and returned to the electrolytic cell. The chlorine may be caused to react with sulphur dioxide and water to obtain a mixture of hydrochloric and sulphuric acids, the latter acid by double reaction with calcium chloride from the dolomite yielding more hydrochloric acid. A part of the hydrochloric acid may be caused to act on the dolomite to obtain a solution from which, by addition of calcined dolomite, is obtained a precipitate of magnesium hydroxide which is converted into magnesium chloride by treatment with the remainder of the acid. Alternatively, crystals of the double salt CaCl₂, 2 MgCl₂, 12H₂O may be separated and leached with water to extract the calcium chloride. See Specification 339,504 (Arnold), dated December 16, 1929, a communication from Dow Chemical Co., of Midland, Michigan, U.S.A.

Ti.

A process for recovering tin from ores, etc., containing iron by treating the material with silicon is described in Specification 338,149, bearing the International Convention date June 22, 1929, by Soc. d'Electro-Chimie, d'Electro-métallurgie et des Acieries Electriques d'Ugine of Paris. The quantity of silicon—e.g., in the form of ferro-silicon—used is such that the resulting ferrosilicon is substantially insoluble in hydrochloric acid or stannous chloride. The ferrosilicon produced may contain 30-33 per cent. of silicon and the tin may be separated from it by utilising the difference of density or by extraction with hydrochloric acid or stannous chloride. Reference has been directed by the Comptroller to Specifications 217,900 and 228,103.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced]

CHROMIUM STAY-BRIGHT PLATING CO., LTD., Birmingham.—Registered March 11, £267 4s. 6d., further charge, to Andrews Metals, Ltd., 63, Legge Street, Birmingham; general charge. *Nil. November 28, 1930.

DRAWN METAL, LTD., Leeds.—Registered March 13,

DRAWN METAL, LTD., Leeds.—Registered March 13, charge, to National Provincial Bank, Ltd., securing all moneys due or to become due to the Bank; charged on land and buildings in Anchor Street, Hunslet. *Nil. December 30,1930.

OFFORDS METAL COMPONENTS, LTD., London, E.C.—Registered March 13, series of £1,000 (not ex.) debentures, present issue £250; general charge

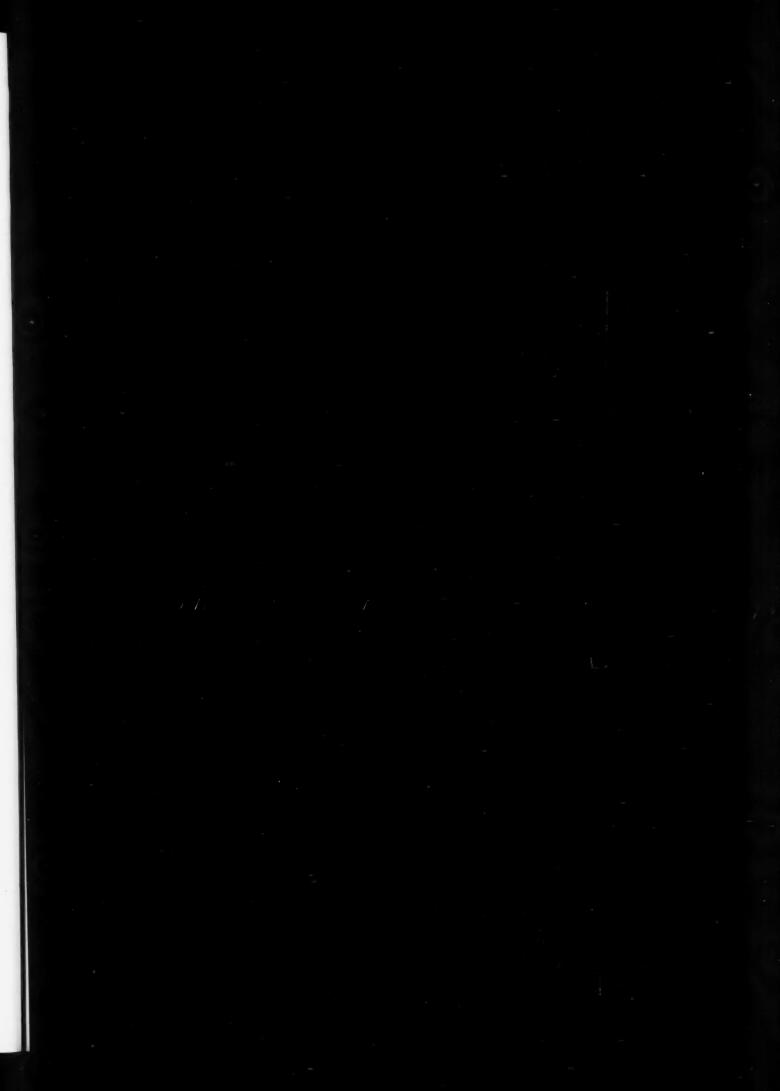
resent issue £250; general charge.

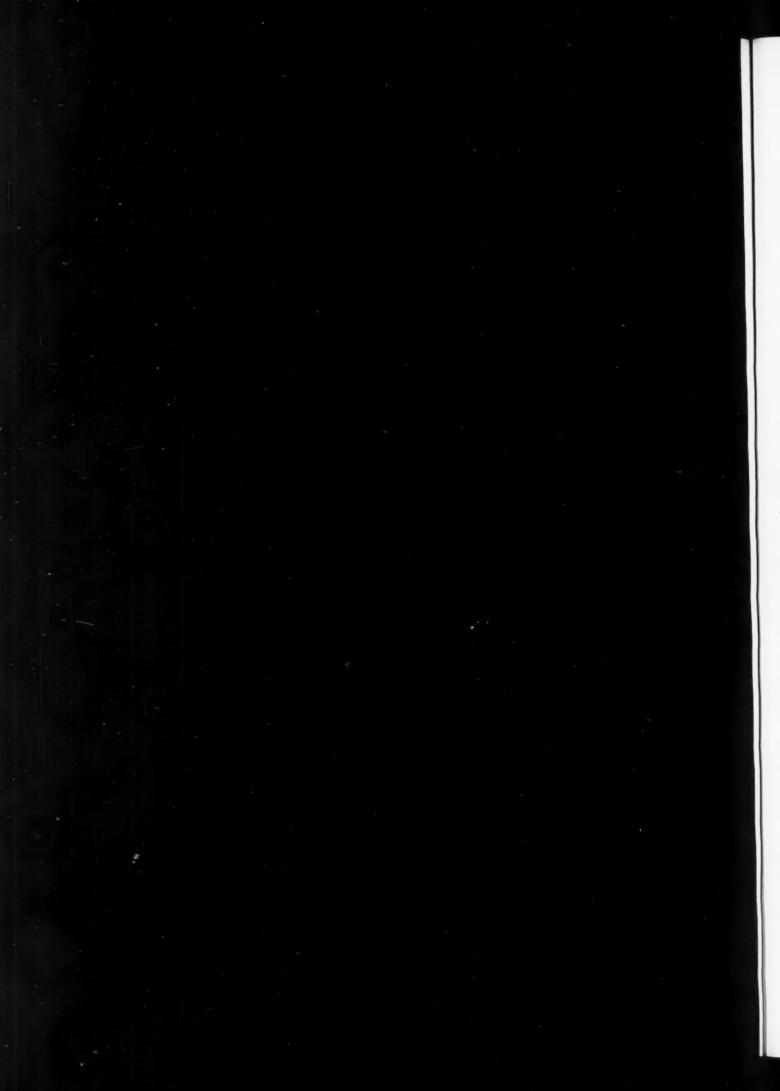
TINDALE ZINC EXTRACTION, LTD.—Registered March
13, £2.500 debentures, to National Smelting Co., Ltd., 95,
Gresham Street, E.C., and another; 1st charge on product of
company's plant at Tindale for a certain period and on moneys
arising from sale of such products, also general charge (subject
to 1st debentures). *£7,000. December 31, 1030.

to 1st debentures). *£7,000. December 31, 1930.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered February 16, twenty-seven mortgages, etc. (sec. 81, 1929 Act), securing £1,280, £1,024, £1,420, £1,190, £640, £1,100, £500, £770, £950, £1,050, £1,200, £1,200, £1,200, £1,200, £1,200, £1,200, £33,133 5s. 5d., £28,502 7s. 9d., £9,052 6s. 9d., £7,250 19s. 6d., £2,925 and £38,656 9s. 3d., to various holders; charged on properties at Laughton-en-le-Morthen, Thurcroft, etc.

ZALAMEA COPPER CO., LTD., London, E.C.—Registered March 5, series of £2,500 secured notes and 25% premium, present issue £922; genera charge. *£43,186. January 1, 1931.





Monthly Metallurgical Section

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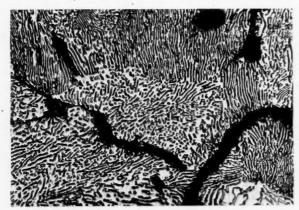
NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor,
THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and
other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points
of interest to metallurgists bearing on works practice or current research problems.

The Microscope in Foundry Practice

I.—Cast Iron and Casting Defects

The following article is published by permission of the Leitz Technical Service, which serves the well-known optical firm of E. Leitz (London) in an advisory capacity for the various problems which arise in industries where the microscope is applicable as an instrument of control in factory operations or processes.

During the past few years foundry practice has been forced to keep pace with many developments which have taken place. First, there has been a noticeable speeding-up demanded in the production of castings, due to the rapid strides taken by newer industries where castings are required for plant or in part for manufactured goods. Simultaneously with this, there has been a greater demand for raw materials, insomuch that



CAST IRON (MAGNIFICATION 600)
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competition for the cutting of prices has caused material of widely different grades to appear in the market, and ways and means have had to be adopted to allow the use of some of the cruder materials where prices must be cut and yet leave a margin of profit for the foundry. Thirdly, foundry practice has received its due share of the results of metallurgical and metallographic research, and specifications which have been formulated on the basis of this research into the "good and bad physical properties of metals" have often to be rigidly adhered to.

Now, whilst the foundry foreman can often tell at a glance if a certain casting is a failure and why it is a failure, there are many cases where casual observation or even a very close inspection will fail to give indication that the casting will not pass the tests to which it is ultimately subjected. The general appearances associated with good and bad cast iron become familiar through long experience in handling it, and even adjustments in correcting defects can be made by trial and error with a marked degree of certainty. Methods of trial and error served their purpose in those days when no better means were available, but to-day the selection of material for immediate requirements must be made without loss of time, considered quite apart from the financial loss involved where trial castings have been difficult to repeat due to some hidden cause which is only revealed by microscopic examination of the structure of the metal.

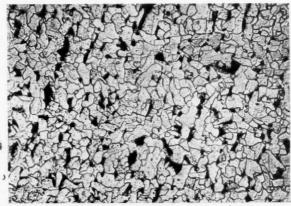
Here, then, it is that the foundry microscope plays its part. It will tell conclusively and quickly, whether or not an iron is constant in quality; chemical analysis, alone, will not do. It is only by properly conducted physical tests, supported by chemical analysis, that the suitability of foundry material

can be more or less definitely established, and even then a microscopical examination will still serve a useful purpose. Besides being used for ascertaining and controlling the quality of your iron, however, it can also be used for materials such as sand and coke. Then there are the castings; the investigation of defects arising from the ultimate composition of iron, the temperature at which it was poured, or bad heat treatment.

The harmful effect upon the strength of castings by overannealing them, is only revealed in detail under the microscope; so, too, is the harmful effect induced by the too
frequently repeated heating of the metal, for all compositions
cannot stand up against such treatment. Rate of cooling is
another factor which has to be controlled. The microscopical
examination of samples of iron taken from castings which
have been accidently chilled by a damp mould, or by the
insufficient drying of the core, will soon show you that extreme
brittleness and general unsoundness is mainly due to cavities
caused by the excessive shrinkage which accompanied the
rapid cooling of the casting. On the other hand, where the
rate of cooling has been too slow, there is also a weakening,
visible under the microscope in the arrangement of the large
flakes of graphite which are present as well as by the segregation
of phosphide. The distribution and shape of inclusions and
graphite flakes are always an indication of quality and ultimate
physical properties, as affected by rate of cooling.

Turning now to the question of specifications, it is to be

Turning now to the question of specifications, it is to be emphasised that if the micro-structure of a cast iron is satisfactory, its physical properties will also be satisfactory and the iron will comply with the most rigid specification. It is tolerably safe to predict that with the new developments in tething and in illuminating the etched surface of the metal under standard conditions, photographs will eventually be-

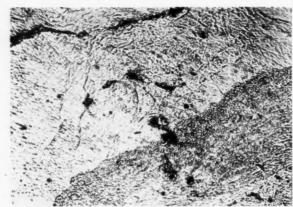


BASIC STEEL (MAGNIFICATION 100)
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come an essential part of nearly every specification which is regarded seriously. The examination of structure under the miscroscope, too, is being more and more used in controlling conditions for the satisfactory annealing of steel castings as well as in the heat treatment of over-hard cast irons.

To take one other instance of the general utility of the

microscope in foundry practices, consider the repair of fractured castings by the "burning-on" process. Here success depends upon getting a perfect inter-crystallisation between the new metal and the old metal. It is difficult to tell from visual observation whether this is attained or not, but the



WELDED IRON (MAGNIFICATION 600).

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microscope will show just to what extent it is attained and will thereby give a comparative indication of strength.

It is not suggested that each foundry should employ an expert full-time metallographist, but rather that there should be someone in control who is capable of handling a simple microscope adapted to the requirements of metallographic work. The foundry foreman and chief draughtsman will then have much to learn from the information revealed by the microscope in its daily use and especially from photomicrographs prepared as and when the occasion seems desirable. Sections cut from different parts of a large casting, for instance, will show the effect of undue wall thickness where the rate of cooling has lagged behind that in other parts of the casting and has, in consequence, produced a corresponding difference in the structure of the metal and it will become obvious that the strength of similar castings can be improved by slight modifications to the design.

Improvements in Production of Cast Iron

It is anticipated that the new plant for the production of cast iron, recently installed at the works of Mason and Burns, Ltd., at Walsall, will ultimately mark another stage of process in the ironfounding industry. This plant, which is of continental manufacture, is only the second of its kind to be installed in England. It comprises a rotary furnace, which is claimed to be capable of producing a much superior metal at a considerably reduced cost compared with present-day practice in ironfounding, and there is the possibility that the plant will ultimately supersede the crucible furnace and cupola which are now generally employed. Powdered coal is used as fuel in the melting operation. As lump coal it is drawn automatically from a bunker from which it passes into an air current where drying is effected by hot air which comes from a recuperator. It then passes to the mill, where it is pulverised, and the powdered coal thus produced is blown by air current direct into the furnace.

If required, this furnace can be used for the production of steel. So far as cast iron alone is concerned, it is claimed that high-test cast iron can be produced from scrap metal and that waste is eliminated. Grey iron, as already produced in this type of furnace, has a tensile strength of 21 tons per square inch; malleable iron has an elongation of 20 per cent. The fuel consumption is stated to be about 12½ per cent. for grey iron, 14 to 15 per cent. for malleable iron, and under 20 per cent. for steel, compared with the weight of the charge. Time occupied in charging and discharging are also important features, for where a charge amounting to three tons is in question charging only takes up five minutes, whilst discharging can be accomplished within ten minutes. Whilst furnaces are still lying idle in parts of the country it is encouraging to find someone with sufficient enterprise taking the "risk" of laying down new plant.

Heat Treatment for Chromium Deposits

The research laboratory of General Motors Corporation, Detroit, U.S.A., has recently been actively engaged in studying chromium deposits, and they have indications that, under some conditions, the durability of these deposits can be greatly improved by the method of plating by heat treatment of the finished product. A series of tests was undertaken in which chromium was plated on copper panels, covering the entire range of possible current density and temperature, but keeping within the "bright range" so as to cover commercial practice. These panels were then subjected to spray tests using a 20 per cent. solution of calcium chloride as corrosion agent. The results obtained indicated that hydrogen might be playing an important part in the character of the deposit, for it is a well-known fact that in the electro-deposition of metals hydrogen is usually evolved, and some of the hydrogen forms an alloy with the metal. An increase in the current density increases the content of hydrogen in the alloy, and an increase in the temperature of the plating bath tends to decrease the content of hydrogen

content of hydrogen.

Panels plated at low current densities and the highest temperatures possible for those current densities, and those plated at high temperatures with the lowest possible current densities for those temperatures, gave the best results so far as resistance to calcium chloride was concerned. It was, therefore, necessary to find some means of removing the hydrogen that was alloyed with the chromium, after the piece had been removed from the plating bath, and heat was suggested as a means of accomplishing this result. Both the heated and unheated test specimens were then subjected to the calcium chloride salt spray, and in every case the heated panels were better than the blanks. Further experiments showed that deposits that had been heated for thirty minutes at 450° F. (232° C.) would stand seven cycles in the spray tests without sign of failure, while unheated specimens usually failed in one cycle.

"Nickel-Clad" Sheet Steel

PROMISING possibilities to the chemical and chemical engineering industries are offered by the development of heavy gauge nickel-clad steel sheet, in which the nickel layer forms some ten per cent. of the total thickness of the plate. The composite product is formed by placing relatively thick slabs of steel and nickel in intimate contact, heating to high temperature, and rolling to finished plate, the close bonding of the two metals being obtained by the alloying of the nickel with the steel at high temperature. Fabrication of this composite product presents no considerable difficulties, since the working properties of the duplex plate do not differ appreciably from those of a solid steel sheet of similar grade. The efficiency of the bond produced, and the ability of the composite material to be severely worked under ordinary shop conditions has, indeed, been very thoroughly tested in the manufacture and assembly of parts for nickel-clad steel tank cars for the transport of caustic soda. An interesting account of the experience which has already been gained in this field appeared in Mining and Metallurgy, February, 1931, and the authors, W. G. Humpton, F. P. Huston and R. J. McKay, therein drew attention to the wide scope of application which exists for such nickel-clad steels. They point out that these products offer a mechanical strength which is superior to that of plain steel and also possess the additional advantage of the corrosionresisting qualities of pure nickel. The advantages of nickelclad tank cars in the transport of caustic soda liquors are dealt with still further by L. A. Belding in Chemical and Metallurgical Engineering, February, 1931. Here it is stated that the stiffening up of caustic soda specifications for rayon manufacture during the past few years has rendered the question of iron contamination increasingly important. A number of manufacturers have therefore resorted to the costly expedient of using fused soda, and the evolution of the nickel-clad tank car, with its guarantee of delivery of the liquid product immune from iron impregnation and discoloration, may be regarded as an event of economic importance in the alkali industry. Nickel-clad tank cars with a capacity of 8,000 gallons are now available to the chemical industry in the United States and it is to be anticipated that they will rapidly find a variety of applications additional to that of transport of iron-free caustic

Metallurgical Topics: Monthly Notes and Comments From Our Own Correspondents

Precious Metals from Refinery Residues

THE Precious Metals Refinery of the Mond Nickel Company at Acton, which was described in this journal last week, is engaged on the end process of a long series of metallurgical operations carried out elsewhere. Part of the concentrates comes from the Clydach Nickel Works of the company, near Swansea, but the richest residues come from Port Colborne, where, too, nickel is refined. In future these will be supplemented by supplies from Copper Cliff as well, where the International Nickel Company, in association with other concerns, has the largest refinery in the British Empire, with a capacity of 120,000 tons of blister copper alone, as well as a silver refinery and a nickel recovery plant. The economic aspects of nickel production are of great interest, particularly in respect of the supply, therefrom, of platinum metals equal to three-quarters of the world's estimated consumption. Nickel to the extent of 41,000 tons was produced last year from the Sudbury ores of Ontario, a slight decline on the production in 1929 (49,000 tons). This output involves the production of considerable copper which, whether there be over-production of that metal or otherwise, must be made if the nickel production is to correspond with the world's demand. It is obvious, too, that if Russia comes into the market with anything like the supply of platinum group metals that could be produced from Soviet resources, some overproduction of those metals as well may be anticipated which would further bring down prices and greatly stimulate the uses of those metals for which a number of applications can easily be found. Amongst these are electroplating, for palladium and rhodium both plate out beautifully on copper producing surfaces of high brilliancy, free from all pitting and porosity. The reflectivity of rhodium is 75, and that of palladium 60, taking silver, the metal of the highest known reflectivity, as 100. As the platinum group metals are non-tarnishable, the lower reflectivity does not greatly matter, and they are especially suitable for reflectors of all kinds, head lights and searchlights, while their uses as alloys present a field almost wholly unexplored.

Production of the Concentrates

The production of the concentrates is the sequel to a series of operations of great interest, of which the refining of blister at Copper Cliff is one of many. At that refinery the blister copper is melted in anode furnaces of a capacity of 300 tons each. There are three such furnaces, and 100 anodes can be cast per hour. After cooling they are taken to the electrolytic tanks, of which there are 1,216 arranged on the Walker multiple system in 32 sections of 38 cells each. In the blister nickel is the most important impurity and segregating cells are employed subsequently to concentrate the nickel sulphate solution which contains 2 per cent. of nickel and 1 per cent. of copper. It is the electrolytic slime from this part of the process which contains the gold, silver, and platinum group metals. discharged through a plug seat in the bottom of each cell, and taken, through launders, to a central sump where, after being screened, it is pumped to the silver refinery. At Port Colborne, of course, similar methods specialised to suit circumstances are employed in a sequence of operations of which the end in view is nickel production. At Clydach, the residues are from the carbonyl process (the Mond process). The concentrates from Clydach are constant in quality whereas those from Canada are likely to grow richer as the time goes on, for the ores of the great Frood mine, the chief source of supply, carry more of the precious metals in proportions as they increase in

Manganese-Silicon Alloys for Killing Steel

METALLIC impurities in steel can, for the most part, be eliminated or controlled, but non-metallic impurities, which often do far more harm in originating flaws or cracks, are much more difficult to get rid of. Yet "cleanliness" in this respect is just as needful as actual metallic homogeneity. Deoxidation products cause a lot of trouble and some deoxidisers almost as much. C. H. Herty and G. R. Fitterer have undertaken an interesting research for the Bureau of Mines, Wash-

ington, on a new range of manganese-silicon alloys for the deoxidations of steel and report very satisfactory results' When steel is "rimmed"—deoxidised with manganese, and, perhaps a small amount of aluminium—the exterior portions of an ingot are apt to be quite clean while the upper central portion may be very badly segregated, and even a very heavy discard may still leave a steel too hard for deep drawing, owing to the carbon segregation. The removal of ferrous oxide and of carbon monoxide is the ideal aimed at, while leaving no deoxidation products behind in the steel. In the present research the rate of the elimination of inclusions was studied, by using a variety of deoxidisers containing silicon (aluminiumsilicon, aluminium-silicon-titanium, etc.) ordinary deoxidisers as manganese, silicon, titanium, and zirconium. Several manganese-silicons were also experimented with and found to give very satisfactory results. particle size, and fusion temperatures, rate of formation, etc., of the manganous oxide and silica formed, and the rate at which they rise in the metal, proved, on investigation with steels so treated, that manganese-silicon alloys can be so used as to ensure clean and well-killed steel.

Nickel-Chromium Steels in the Oil Industry

In the course of a survey of the activities of the American Petroleum Institute in relation to the corrosion problems encountered in the oil industry, V. V. Kendall and F. N. Speller, in a recent issue of *Metal Progress*, have presented some data on tests made by eight co-operating oil companies on the behaviour of special steels when subjected to oil refinery conditions. The materials tested were high-nickel and high-chromium steels, two samples of which contained small additions of silicon and aluminium. Laboratory results, in the case of the low-carbon nickel (8 per cent.) chromium (18 per cent.) steel were favourable, and read in conjunction with the reports of its chemical and physical stability under actual service conditions, they seem to indicate an increasingly useful future for this material in the construction of oil-cracking plant.

Remelted Metals and Use of Scrap

An exceedingly interesting discussion took place on the occasion of the annual meeting of the London Section of the Institute of Metals on April 5, on the subject of the remelting of metals and the use of scrap. It was opened by Mr. A. H. Mundey, who detailed his experiences in making gun metal and printing metal alloys, and strongly advocated the pre-melting of all metals and alloys employed. Even virgin metal gained from such treatment. Opposite views were expressed by Mr. H. C. Dews, who said he had seldom been able to find that ingoted metal was better than new metal. In regard to the use of scrap, opinions were equally divided amongst the speakers, some being of opinion that scrap should always be remelted and ingoted and others that there was nothing to be gained from such practice. Dr. W. Rosenhain emphasised the desirability of uniformity in melting, and gave instances where trouble was experienced through the difficulty of getting some constituents of a melt to mix properly with the rest. He also pointed out that whereas approved scrap should possess advantages when derived from metal known to give good service, much scrap, even from such sources might, as in the case of runners and risers, be badly contaminated with dross. Points made during the discussion, which was inconclusive, were that virgin metals were by no means necessarily -one speaker instanced a spelter with which he had had to deal, which contained 2 per cent. of lead—nor was all scrap necessarily bad. Other points were that the remelting of metals sometimes led to the pick-up of deleterious matters, but the time available for the discussion did not allow of that aspect being fully elaborated, while another was that such benefit as accrued from the remelting of metals was due to the implied subsequent solidification rather than to the melting itself, although as the former is an inevitable result of the latter (except when a remelted metal is poured, in the molten conditions into the melt) it hardly seems, from a practical point of view, necessary to discriminate between the relative effects of remelting and resolidification.

Foundry Sands

Following the recommendations of the American Foundrymen's Association's Committee on Moulding Sand Research is the publication of standards and of tentative standards for the testing and grading of foundry sands, which should prove of the utmost use to foundrymen the world over. The standard tests comprise the ascertainment of moisture content, perstrength, fineness, refractoriness, and durability or life. Methods for the chemical analysis and the grading of sands have been approved and published already, but are reincluded in the present publication, which is a perfect vade mecum on the subject of foundry sands generally. Its scope may be gauged from the following brief synopsis of its contents. The introduction gives a history of the inception of the idea of undertaking the research and of the machinery devised for carrying it out. Section II deals with sampling, under the headings of size, and mode of sampling varying consignments of sand, from wagon loads to shiploads, and the subsequent methods of crushing, halving and quartering the sample which, although simple, need to be done with care, and under constant conditions. The further sections deal with the subjects already enumerated, but in greater detail, and under many subheadings. Thus permeability testing is discussed with reference to the Standard definition of permeability, to the apparatus needed for testing for this property and the mode of conducting the test, differentiated according to whether green sand or baked or dry sand is to be tested, a special sub-section being devoted to mould surface permeability. The section on strength testing is equally detailed, and describes such compression tests as the Seager, Adams, Dietert, and Federal Foundry Co.'s tests, while bar strength, tensile strength, and shear strength testing are also described. Of other tests to which foundry sands are subjected, dye absorption, sintering and cone tests are specially dealt with. The text is accompanied by dimensional drawings of the tests and of the apparatus used.

Molybdenum in the United States

According to data which has been collected by the U.S. Bureau of Mines, the production of molybdenum ore in the United States during 1930 was slightly less than in 1929, but substantially greater than in 1928 or any preceding year. The production in 1930, as estimated on the basis of reports from the leading producers, amounted to approximately 6,167,000 lb. of molybdenum sulphide. Most of this material was represented by concentrates, although a small amount of high-grade ore was shipped from the mines without concentrating. Shipments of concentrates and ore from the mines contained an equivalent of approximately 3,700,000 lb. of actual metallic molybdenum, valued more or less arbitrarily, at \$2,000,000. By far the bulk of this production was used in steel manufacture, chiefly in aircraft and automobile steels, to a smaller extent in special steels for bearings, steel castings, and in corrosion and high-temperature resisting alloys, but an important outlet has developed in the production of nickelmolybdenum-iron alloys, which may contain as much as 20 per cent. molybdenum and are capable of resisting the action of hydrochloric acid. Molybdenum wire is used as the supporting filament in the manufacture of certain types of incandescent lamps and radio valves. In purely chemical matters there has been noteworthy developments in the use of various catalysts which contain molybdenum oxide, chiefly in connection with the hydrogenation of oils and in the production of motor fuel from the heavier constituents of crude petroleum.

Molybdenum is introduced into steel principally in the form of calcium molybdate or molyte, but the use of ferro-molybdenum is said to be on the increase despite the fact that its price is higher. In April, 1930, the Molybdenum Corporation of America acquired the ferro-alloy and chemical plant of the York Metal and Alloy Co., and has subsequently produced molyte and ferro-molybdenum at its plant in Washington, whilst devoting attention to calcium molybdate, ammonium molybdate, sodium molybdate, molybdic oxide and other chemicals at York, Pa. The capacity of the mine and mill of this company at Questa, New Mexico, was practically doubled as a result of the installation of a new power plant and the addition of new flotation cells. In Colorado, the Climax Molybdenum Co., the largest molybdenum producers in the world, completed its new crushing plant and is now in a

position to supply from 7,000,000 to 8,000,000 pounds of the element annually; this quantity is approximately twice as much as the world has hitherto consumed in any one year.

Alloy Steels at High Temperature

In view of the length of time involved in long-time "creep" testing, and of the probability that a large amount of valuable preliminary information may be obtained by means of short-time high-temperature tests, W. Kahlbaum, R. L. Dowdell and W. A. Tucker (U.S. Bureau of Standards, Journal of Research, February, 1931) have studied the short-time tensile properties of a variety of materials at temperatures varying over the range 70°-1360° F. (20°-740° C.). The steels tested over the range 70° –1360° F. (20°–740° C.). The steels tested cover a wide range of composition, being selected primarily with a view to showing the effects of certain alloy elements on high temperature properties; and include chromiumvanadium, chromium-vanadium-tungsten, chromium-tungsten, nickel-chromium molybdenum, and austenitic steels contain ing high nickel and chromium, with or without tungsten. Detailed examination was made of the structure of the alloys before and after testing, and in addition, hardness was determined, as an indication of possible tempering effects produced during heating for test. The results fully confirm the superiority of alloy steels over carbon steels for high-temperature The proportional limit of the carbon steel at elevated temperatures was very much lower than that of any of the alloy steels at corresponding temperatures, and, when stressed beyond the elastic limit, the alloy steels showed a stress-strain curve which deviates much less from a straight line than that given by the carbon steel. Comparison of the values obtained for "short-time" and "creep" tests on identical materials indicate that the former test cannot satisfactorily replace the "flow" test as a criterion of the load-bearing capacity of steels at high temperatures

Resistance of Nickel Alloys to Phosphoric Acid

The interest recently evinced in the manufacture and use of phosphoric acid has created an urgent need for more accurate information on the relative resistance of metals and alloys to corrosion by solutions of different concentrations. In response to this demand a systematic investigation of the subject has recently been made in the laboratories of the Bureau of Chemistry and Soils, Washington. As a preliminary step, existing literature and information obtained from unpublished sources has been correlated and published. In the tests which have been carried out, an attempt has been made by means of high-temperature, the use of agitated solu-tions exposed to the air, and the employment of impure solutions, to simulate as closely as possible industrial plant conditions. The behaviour of 52 different metals and alloys has been investigated, in contact with 10, 25, 50, and 85 per cent. C.P. acid, and with dilute and concentrated acids. The materials subjected to test included a large number of nickel-containing compositions, among which were the following:—monel metal and other nickel-copper alloys, nickel-chromium and nickel-chromium-silicon steels, nickel, "Illium" chromium and nickel-chromium-suicon secces, containing (complex high-nickel, nickel-chromium alloy, containing molybdenum and copper), "Nichrome," and alloy). Various conclusions drawn indicate that certain of the nickel-bearing alloys constitute very promising materials of construction for use in contact with varying solutions of phosphoric acid.

Decreased Consumption of Nickel

According to the annual report of the International Nickel Co. for the year ended December 31, 1930, sales of nickel in all forms, including alloys, amounted to 75,284,352 pounds, as compared with 125,577,789 pounds in 1929. This report gives the world's consumption of nickel in all its forms during the past year as 88,000,000 lbs. in 1929 and 117,000,000 lbs. in 1928. While sales of nickel to the steel industry were substantially less than in 1929, some newer uses for nickel steel actually registered increases, the most prominent in this connection being increased production of nickel steel castings. Both in Canada and the United States increasing quantities of nickel steel are being used by the railroads for locomotive castings, forgings and boiler plate. Production of corrosion-resistant nickel-chromium steels (stainless steel) also increased by approximately 10 per cent., and in addition to these alloys in sheet and other forms, many foundries are producing castings.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

In our survey of the iron and steel trade during the month of April we are unfortunately compelled to report that there is no improvement. It is to say the least unpleasant to have to make this depressing statement month after month, but we have to speak of actual conditions, and they certainly do not warrant any misleading optimism. It is true that the March output figures are slightly better than those for February, but it is a casual difference in no way indicative of better trade; and it will be very surprising if the April figures are not considerably down again, seeing that the Easter holidays interfered with production. The prolonged scarcity of orders is the lament of every steel maker, and on the top of this there is practically no demand from which to expect new orders. Those who are inside the industry know from their own experience, as well as from the official weekly returns circulated by the steel associations, how deep and unrelieved the depression is.
Where is a revival to start? Political influences do not seem likely to encourage it: the opposite is rather more probable.

The shadow of Budget day may be holding up business, and by the time this is in print it will be known what the Chancellor of the Exchequer is going to do for us, but the expectation is not a happy one. The low level of commodity prices, which some months ago seemed to be the basis of hope for an upward movement, is likely to continue, if it does not get worse. It is certainly not bringing out any volume of new business, as buyers know that they can still force further reductions for all products which are not controlled by the associations. Something will have to happen to restore confidence before we can see any revival in trade, but what that something may be we are entirely at a loss to predict.

Disastrous Effect of the Slump

The financial results of the past year are beginning to make their appearance, and they tell in no uncertain manner how disastrous the slump has been and still is. In numerous instances losses have been reported, but perhaps the greatest surprise was the announcement that Guest Keens had passed their ordinary dividend, after paying 10 per cent., free of tax, for so many years in succession. It is significant that they have disposed of their iron and steel works to the new subsidiary company, as the steel-making section of their activities has suffered severely during these years of depression, and it is hoped by the new arrangement to make a better showing. Another official announcement that has just been made is the closing down of the large steel-making plant of John Summers and Sons, Ltd., of Shotton. It is stated that the usual weekly pay roll of about £26,000 for about 6,000 persons has fallen to an average of less than £6,000 weekly. This company has been hard hit by continental competition, and as they find it impossible to carry on their steel works with the present high cost of labour and taxation they have stopped the production of steel and are buying what they require from the Continent. It is a serious blow to the workpeople in that district.

A Government Reorganisation Scheme

The past month has seen a renewal of the official threats for Government control of the industry. Encouraged no doubt by what they have achieved in the coal mining industry, the labour party seem to be intent on trying their hand on the iron and steel trade. The president of the Board of Trade is their spokesman on this matter. In a recent speech at Scunthorpe he said that it is the intention of the Government to introduce a bill in the autumn to compel the reorganisation of the steel industry. The scheme provides for the grouping of all the steel works into four districts, North East Coast, Midlands, South Wales, and Scotland. The Lancashire steel works have already taken this step, which was the only thing for them to do, as the several units prior to the formation of the Lancashire Steel Corporation were all ultimately under one control. According to the scheme, each region would concentrate on the production of those classes of iron and steel most suitable for it, orders would be pooled and given out to

the works best fitted to execute them; and if necessary there would be financial mergers of the different undertakings. It all sounds very simple. It is said that the firms in the industry give general approval to a scheme of this kind but the authority for that statement is doubtful. The steel makers have told the Government plainly that it is useless to reorganise unless they have an assured market at least in the United Kingdom, and that therefore the preliminary step must be protection from foreign dumping. The Government refuses to give this protection, and apparently the deadlock is to be removed by compulsion. It looks rather like an instance of bullying in order to cover up the neglect of an obvious duty. The report of the Economic Advisory Committee, on which the proposed scheme is based, will no doubt be submitted to very severe criticism.

Possible Effect of Government Control

There is one point we have mentioned which is of interest as illustrating one of the troubles of the industry. The proposition is that each region shall concentrate on the production of that class of steel most suitable for it. But how will that be The same classes of steel are made in each of the areas specified, and each one claims that it can make steel as well as if not better than any of the others. Each works, to the extent of its capacity, has laid itself out, or is doing so, to produce whatever kind or quality of steel is likely to be required in any district, and from this has evolved an internal competition which has no better result to show than the splitting up of the available business among a greater number of works, and at considerably lower prices than would have been necessary if the trade had been left with those works who had originally developed it. This has been particularly noticeable in the case of special qualities, which originally commanded a higher price than ordinary steel, and which enabled the makers to balance the losses or low returns on ordinary products. Now much of this margin has disappeared; indeed, in many cases there is no difference in the prices. The annoying part is that consumers were quite willing to pay the extra until they found some maker foolish enough to waive it in his eagernes to steal a march on his competitors, and having once secured the concession they have forced it on all suppliers. It was the individualist policy of many of the colliery owners which was in a large measure responsible for governmental intervention in that industry, and a similar selfishness amongst steel makers may lead to the same result.

Dull Reports from Steel Producing Centres

There is a cheerless similarity in the trade reports from each of the steel-producing centres. London, which is not one of these, continues to report improved conditions and a better demand, but as there is not the least foundation for this report no one pays much attention to it. From the North East Coast, the Midlands, South Wales and Scotland we have the same story of dullness, without any sign of expansion in the demand. Business in pig iron continues to decline. There are now only about half the number of furnaces in blast, as compared with last year. Both foundry iron and hematite are affected, and there is a tendency for prices to weaken still further. No better news can be given of the semi-finished and finished steel markets. The steel makers at their joint meeting in April decided to make no change in prices, but the uncontrolled materials are inclined to ease in price. There appears to be a little improvement in the continental position, as prices from Germany and Belgium are rather firmer. For billets and small bars their prices are so attractive that a good share of this business is going to the foreign works.

The production returns for March show that there were 81 blast furnaces at work, with a production of 357,100 tons of pig iron, compared with 318,200 tons in February. For March last year the output was nearly double that figure. The output of steel for March, 1931, was 500,100 tons compared with 486,400 tons in February, or again not much more than half the amount for March last year.

Some Inventions of the Month By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in The Chemical Age.

Alloys for Soldering

A SOLDER in the form of a copper-phosphorus alloy described in Specification 342,592, International Convention date, March 26, 1929, by Associated Electrical Industries, Ltd., of London, Assignees of O. W. Ellis of Toronto, Canada, contains between 2·5 and 6 per cent. of phosphorus, and may be made by adding phosphorus, or preferably phosphor-copper, to molten copper. To obtain the alloy in ductile strips it is repeatedly rolled at 350–650° C., starting preferably with cast ingots of 0·25-1 inch thickness, until a thickness of 0·04–0·021 inch is attained, and thereafter is reduced by cold rolling to a thickness of 0·015–0·010 inch. No flux is required in brazing copper, brass, or bronze to copper, but the use of a flux such as microcosmic salt or borax is necessary in brazing copper-silicon and like alloys.

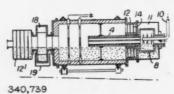
COPPER-NICKEL alloys described in Specification 341,340, International Convention date April 6, 1929, by Allgemeine Electricitäts-Ges. of Berlin, are used in soldering metal articles by heating in a reducing atmosphere to cause them to enter between and alloy with the surfaces to be united. If the melting-point of the solder is too high an additional fusible metal such as zinc, lead, aluminium, or cadmium may be added. An alloy containing 64 per cent. of copper, 25 per cent. of nickel, and 11 per cent. of zinc is specified as an example, and the soldering of cylinder covers, pistons, and other parts of internal combustion engines is referred to.

Concentrating Ores

In a flotation separation process described in Specification 340,598, dated October 2, 1929, by H. Lavers and Minerals Separation, Ltd., of London, oxidizing agents such as bichromates, permanganates, chlorates, persulphates, or hydrogen peroxide are added to the flotation pulp, either during grinding or subsequently, to destroy flotation poisons in the form of soluble metal salts, such as ferrous sulphate, which may be present in the minerals to be concentrated. In an example copper sulphides are separated from iron pyrites with the use of potassium bichromate as oxidizing agent, lime as a depressant, and cresol, pine oil, and potassium xanthate as flotation reagents.

Extracting Iron

In the reduction of iron ores in a rotary electric furnace a preheating of the ore by the reaction gases is effected, before its admixture with the carbon, in a chamber arranged to rotate with the furnace. The ore is fed into a tube 4, constituting the preheating chamber, through an enlarged portion 8 in which the gases are burnt by means of air from a pipe 10. The carbon is fed to an outer chamber 11, and passes into the



furnace by way of a lock 12 in the form of spaced plates 14 with unalined peripheral openings. The furnace discharge is by way of a cooling chamber 18 and a lock 12\frac{1}{2}. To effect the cooling, the corrugated surface of the chamber 18 dips into liquid in a container 19. See Specification 340,739, International Convention date December 10, 1928, by B. M. S. Kalling and C. Von Delwig, of Avesta, Sweden.

Hardening Cast Iron

A LOCAL hardening of cast iron in such processes as the formation of turning or other machine tools is effected by bringing a non-ferrous metal, such as copper or a copper alloy, into close proximity to the iron and generating an intense heat by the passage of an electric current between them so that the non-ferrous metal is caused to penetrate into the iron. A continuous arc may be struck or an intermittent contact, such as

is used in flash welding, may be employed. The cast iron electrode may be sheathed in the non-ferrous metal or a cast iron bar may be mounted in a practically closed crucible between pairs of contacts of the non-ferrous metal, and a heavy current passed to melt the metals at the points of contact. See Specification 340,530, dated September 27, 1929, by W. Meacher, of London.

Phosphorus Steel

The preparation of an easy-machining steel for pressed nuts, etc., having a high phosphorus content, is described in Specification 339,946, bearing the International Convention date, December 22, 1928, by F. Borggraefe, of Weidenau, Sieg, Germany. A mixture of scrap iron, siliceous pig iron, and a material rich in phosphorus—e.g., basic pig iron, apatite, vivianite, or ferro-phosphorus—is first melted down in a cupola, the phosphorus content of the melt being adjusted to that required in the final product, whereupon the melt is decarbonised in an acid-lined Siemens-Marten furnace, with or without addition of ferromanganese as a deoxidising agent. The production of a steel containing 0·2·0·5 per cent. of phosphorus, 0·3·0·6 per cent. of manganese, 0·04-0·1 per cent. of carbon, 0·05-0·15 per cent. of sulphur, and up to 0·25 per cent. of silicon is described in an example.

Protecting Metals against Corrosion

To produce a protective coating on surfaces of aluminium or magnesium, or on alloys containing them, the metal or alloy is immersed in a bath of an alkaline solution of a salt of which the acid radicle contains a metal other than chromium capable of forming at least two oxides. Thus the use of vanadates, molybdates, tungstates, titanates, uranates, niobates and manganates, or of mixtures of two or more of such salts, is specified. In an example an aluminium article is immersed in a boiling solution containing about 0.5 per cent. of sodium or potassium molybdate and about 1 per cent. of sodium carbonate. Alternatively the article may constitute an anode in an electrolytic bath containing the solution and be subjected to a current of an intensity and duration dependent on the temperature of the bath and the thickness of the coating desired. See Specification 342,256, International Convention date November 10, 1928, by C. Boulanger, of Clichy, France.

Refining Copper

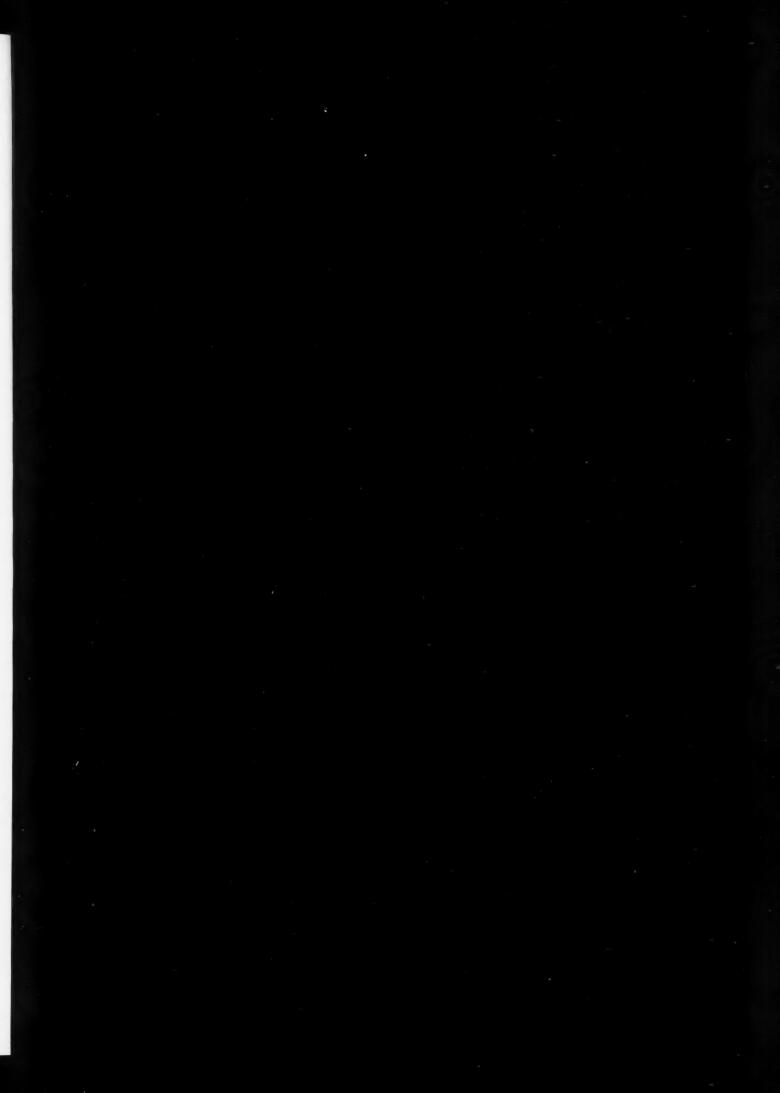
A METHOD of refining copper to obtain a product of high electrical conductivity, capable of being heated in a reducing atmosphere without becoming embrittled, is described in Specification 340,497, International Convention date March 8, 1929, by Electrical Research Products, Inc., of New York, U.S.A. Assignees of J. E. Harris, of Newark, and J. H. White of Cranford, New Jersey, U.S.A. Molten pure (e.g., electrolytic) copper is, for this purpose, placed in a vessel lined with a refractory material capable of preventing any transfer of impurities from the vessel to the copper, and a deoxidising agent is added. In an example the vessel is made of a fireclay-graphite mixture, the lining of substantially pure alumina, or magnesia, and o'l per cent. of crystalline calcium boride is added just before pouring. Reference has been directed by the Comptroller to Specification 16,307 of 1913.

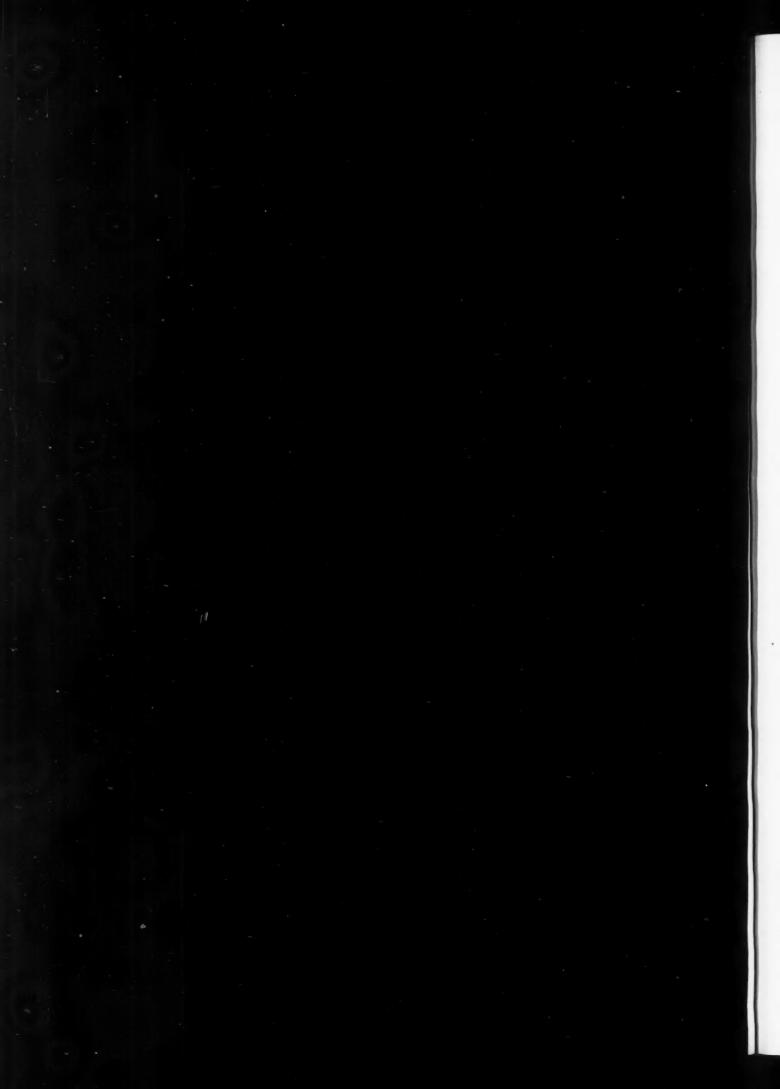
Refining Nickel

Nickel and its alloys are deoxidised by the addition of lithium to the molten metal or alloy, according to Specification 340,632, International Convention date April 29, 1929, by Berndorfer Metallwarenfabrik A. Krupp Akt.-Ges., of Berndorf, Austria. The lithium is preferably used in the form of an alloy containing 85 per cent. of magnesium and 15 per cent. of lithium, and the amount added may be 0.001 to 0.1 per cent. of lithium based on the weight of the nickel or nickel alloy.

Cadmium in Bearing Metals

REVERTING to the note on this subject which appeared in THE CHEMICAL AGE, April 4, Monthly Metallurgical Section, page 22, the Eyre Smelting Co., Ltd., of Tandem Works, Merton Abbey, London, S.W.I, has drawn attention to the fact that tin base white metals, as now produced, are regularly carrying loads far in excess of 500 lb. per square inch, which was the figure mentioned by our correspondent. They state that a pressure of 1,500 lb. per square inch has been reported from tests carried out at the National Physical Laboratory.





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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor,
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other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points
of interest to metallurgists bearing on works practice or current research problems.

The Microscope in Foundry Practice

II .- Equipment for the Metallographic Laboratory

In the previous article under this heading, which appeared in The Chemical Age (Monthly Metallurgical Section), May 2, the way in which the microscope can materially assist the work of the laboratory was briefly outlined. This concluding article deals with the choice of suitable metallographic equipment.

MICROSCOPE makers who have considered the needs of the metallurgist or metallographist have devoted a considerable amount of their time to the perfecting of instruments which can be handled and successfully manipulated by anyone possessing a reasonable degree of intelligence. Wherever possible the equipment is so constructed that a minimum attention is required to obtain critical illumination, whilst

optical and mechanical parts which need handling are so arranged that the smallest number of movements are The complicated metallographic microscope

of the old days has served its purpose and has gone; to-day the maximum efficiency for good serviceable results is attained without any noticeable physical or mental strain on the person into whose hands the equipment is entrusted for use.

In the immediate need for a workshop microscope which may be placed direct on large castings and sheets for the closer inspection of defects, or for observing the results of various tests, there is no more serviceable instrument than that illustrated in Fig. 1. This microscope has a horseshoe foot which is provided with levelling screws, so that whatever the shape of the casting, or the aspect from which observation is to be made, it is quite simple to adjust matters for obtaining a perfect, undistorted image. Illumination (as in the case of all modern microscopes where opaque objects have to be examined) is "vertical," and in this particular microscope it is vertical illumination its simplest form, the source of light being a small 6 or 8 volt filament lamp in a protected casing which is directly

secured to the instrument and has merely to be connected with the necessary electric current by a flexible lead. Such an instrument as this will give magnifications ranging from 16 to 100, or from 16 to 450, diameters according to the power of the eyepieces

and objectives chosen for use. Fig. 2 shows a "material testing microscope, designed essentially for the examination of metals in use at small engineering works, wire-drawing and metal-rolling mills. It is, however, a very convenient instrument to select for the small foundry where the amount of work to be done does not justify the

installation of complete metallographic equipment. Here magnifications ranging from 20 to 800 diameters can be obtained, and there is a detachable camera for producing photomicrographs which are of a convenient size to show the

low voltage filament lamp which is permanently attached in a protected casing and which, once adjusted, will only require occasional correction to restore its centration. The object stage, it will be noticed, is of the inverted type, which allows the polished metal specimen to become instantly levelled in respect to the optical axis. The camera is so mounted that

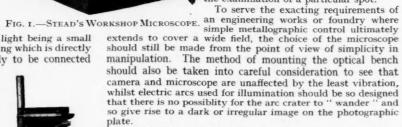
photomicrographs can be made almost immediately after a specimen has been under ocular observation through the eyepiece, and if the building in which the equipment is used is subject to much vibration it is still possible to secure sharp images by using the spring-mounted table

also seen in the illustration.

An additional feature of interest, in the microscope illustrated as Fig. 2, is the method which has been adopted for mounting the microscope in the heavy cross-piece carried by the upright pillar which is rigid with the sole-plate of the instrument, for here it is possible (by a single movement of the hand) to rotate the microscope through an angle of 180°, so that the objective will point downwards instead of upwards, when

necessary, for the examination of large or abnormally-shaped surfaces or pieces of metal which are too heavy to place on the object stage. A com-

parison of Figs. 3 and 4 shows this adaptation, where the surface of a length of shafting is under observation and the sole-plate of the instrument is temporarily equipped with V-shaped feet which straddle the shafting and so provide a rigid arrangement for the examination of a particular spot.



For grinding and polishing metallurgical specimens there are a variety of machines to choose from. Special attention, however, may be drawn to those machines which are equipped with several spindles, the design of which has been evolved from a close study of the technique involved. In these machines, which may be

equipped with two, four or five vertical spindles, the grinding and polishing discs are arranged in consecutive series, and to facilitate cleaning they are run in enamelled pans which are mounted upon a rigid base. pans, moreover, can be closed

by hinged covers to protect

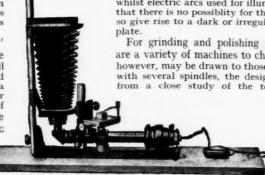


FIG. 2.—WORKSHOP MATERIAL TESTING MICROSCOPE. Reproduced by permission of E. Leitz (London).

detail ordinarily required. As in the case of the workshop discs which are not in immediate use, but the whole of the microscope already described, the source of illumination is a

spindles are driven as one unit by belt gear and countershaft,

or direct from a small electric motor. The five-spindle machine in its standard form is equipped with a coarse-grinding carborundum disc, three discs for emery papers of different grades, and a polishing disc for cloth lining, and thus renders

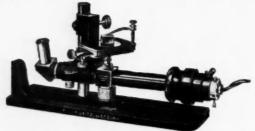


FIG. 3.—MATERIAL TESTING MICROSCOPE IN NORMAL POSITION FOR USE.

the machine available for carrying through in one continuous operation the entire process ranging from the first coarse grinding of the raw specimen to the final polished plane.

In cases where the amount of work to be done does not necessitate the use of a five-spindle machine, single-spindle machines are also obtainable, but have the requisite discs required to be put in operation by successive inter-changing. Specimens can, of course, also be ground by hand, using a suitable flat surface provided with the necessary abrasive medium, but mechanical aids for the final polishing are always desirable.

The quality of the microscope image of the structure of a metal required for constructive or manufacturing purposes is

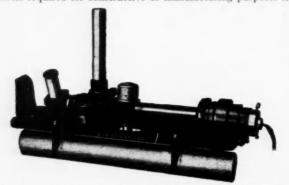


FIG. 4.—ADAPTATION OF MATERIAL TESTING MICROSCOPE FOR EXAMINATION OF HEAVY OBJECTS.

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largely determined by the manner of its preparation. It is not always an easy matter to produce a plane surface suitable for critical examination under the microscope, where the material in question is in the nature of a thin sheet or round rods of very small cross-section (such as cast iron radiators, tubes or wires, but with large pieces, such as coarse fractures, there is not so much difficulty in obtaining a plane surface, as such pieces can be conveniently held in the hand whilst the operation of grinding and polishing is carried out. It is for this reason that mechanical grinding and polishing aids should never be considered unnecessary accessories for the microscope employed in a small foundry where metallographic research is of secondary importance to the control of actual foundry operations.

Heat Treatment of Steel Advantages of Molten Salts

The advantages to be gained by the use of molten salt baths in the heat treatment of steel, in comparison with lead baths, are outlined in great detail in recent literature which has been published by the Cassel Cyanide Co., Ltd., of Oldbury, near Birmingham.

The difficulties attendant upon the successful heat treatment are said to be (a) control of temperature, (b) avoidance of scale and decarburisation, and (c) prevention of distortion

and cracking on quenching. In the muffle type furnace, even when pyrometers are employed, a great deal depends upon the skill and experience of the operator, who can only judge by eye whether the parts under treatment are at the correct temperature. The position of the thermo-couple in the furnace is important, as the incidence of hot gases and incandescent brickwork may materially affect the pyrometer readings. In the salt bath the temperature is uniform throughout, as the salt is in constant gentle motion, thus distributing the heat by conduction and convection. Steel immersed in such a bath is uniformly heated, and its actual temperature is accurately shown on the pyrometer indicator.

Scale and Decarburisation

In muffle furnaces the prevention of scale is only possible when expensive installations with water or gas seals are employed; a salt bath equipment for a similar output is not only much more compact and cheaper, but yields a cleaner job, as its immersion in the fluid bath affords complete protection from atmospheric or furnace gas oxidation. When the work is removed from the bath, a thin film of salt adheres, giving complete protection until the article is actually in the quenching tank. In this respect salt baths are preferable to lead baths, as the latter accumulate dissolved oxides which attack the surface of the steel.

These remarks on scaling apply to a certain extent to decarburisation. The impossibility of obtaining a completely neutral atmosphere in a muffle furnace is admitted unless artificial atmospheres are employed, and either an oxidising or reducing atmosphere can alter the composition of thin sections or edges of a component. This point is therefore of considerable moment when treating such articles. Certain salts can also decarburise, but the addition of cyanide completely prevents this

Prevention of Distortion

During the hardening operation it is possible to produce distortion by uneven heating or improper quenching. If a cold steel component is placed on the hot hearth of a furnace, that portion in contact with the hearth will heat more rapidly than the remainder which is being heated mainly by radiation. The part which is heated more rapidly also expands more rapidly than the cooler portion; this results in curvature, unless the mass of the piece is sufficient to keep it straight. While trouble from this cause can be largely prevented by heating small pieces on racks and grids, such devices take up space in the furnace and reduce its output. In the salt bath furnace each piece of the charge is in intimate contact with the molten salt, which is at a perfectly uniform temperature. The piece is therefore heated uniformly, and uneven expansion avoided.

It has been shown that a very rapid rate of heating may result in distortion. In this respect the salt bath also has a distinct advantage over molten lead. Lead, being a better conductor of heat than molten salts, heats an immersed piece more quickly than salts, but when a cold piece of steel is immersed in a salt bath, a skin of frozen salt chills around the steel. This salt has a high latent heat, and appreciable time is required to melt it, thus heating the steel comparatively slowly. Lead, on the other hand, has a lower melting point than any heat treatment salt, and has a lower latent heat and will, therefore, heat immersed pieces more rapidly than do salt baths, with consequent disadvantages.

Quenching Temperatures

To obtain maximum hardness, the quenching temperature must be exactly controlled. This point can be determined with the greatest exactitude in the molten bath. The adhering film of salt or lead must not interfere with the contact of water or oil with the steel. In this respect lead may be a disadvantage, since, if it adheres to a job in the quenching tank, it prevents the free access of the quenching medium to the part, resulting in softness. Lead is, of course, insoluble in commercial quenching media. Some salts are more soluble than others, and, therefore, the composition of the heat treatment bath is important, as the more soluble baths yield the hardest jobs.

Cracking on quenching may be caused through defects in the steel, but a more usual cause is improper manipulation. Steels of certain compositions are more liable to crack than others, but if the maker's instructions are implicitly followed this should not occur.

Metallurgical Topics: Monthly Notes and Comments From Our Own Correspondents

Corrosion of Iron and Steel

THE preliminary report of the Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers, to the Iron and Steel Industrial Research Council embodies an enormous amount of work, the ultimate results and conclusions from which must be deferred until a further report is ready. For what has already been accomplished the very greatest credit must be given to the Committee, the workers to whom the investigations were entrusted, and to the chairman, Dr. W. H. Hatfield, whose reputation will be further enhanced by the publication of this report. To discuss it in anything like detail would be beyond the space limitations at our disposal. It must suffice to say that not only are field tests being instituted on a vast scale, but that such accelerated corrosion tests as the Committee has decided to carry out are of a well designed nature calculated, if not to satisfy the many objectors to this kind of test, at least to range in a useful and informative "order of merit," the ferrous materials selected for the tests. It is, of course, well known that even ordinary mild steel contains much more than merely the carbon, phosphorus, sulphur, manganese and silicon which are the constituents analysed for in routine analysis. however, be a revelation to many that what the Committee has selected as typical of ordinary mild steel should contain as much arsenic as is shown by the analyses accompanying the report. This element often "comes down" with the phosphorus, but if that present in the steels referred to had done so it would have misrepresented, to a formidable degree, the phosphorus content of these steels. It might be well to state, in a subsequent report, whether any of them originally contained copper as well, as this, too, can generally be found in steel, if looked for. Finally, in a corrosion research it would be valuable to have the oxygen content of the steels The presence of that element would have an appreciable result on their corrosion resistance.

The Basic Bessemer Steel Question

THE annual meeting of the Iron and Steel Institute which took place at the Institution of Civil Engineers last month was well attended and the papers read and discussed of more general interest than usual. Particularly was this the case in regard to the paper by Mr. Vernon Harbord entitled "The Basic Bessemer Process, Some Considerations of its Possibilities in England" and the discussion to which it gave rise. The paper stated the case for a basic Bessemer revival in this country without holding, in any way, a brief for basic Bessemer steel itself, and Mr. Harbord was, in all probability, wise in treating his subject along the lines selected and dwelling only on the possibilities of the process which was once widely employed in the country of its origin but has since fallen almost entirely into disuetude. At the same time the discussion showed that the possibilities of a basic Bessemer revival in this country are inseparably linked with the question of the nature of the product and that the prejudices which led to its abandonment are as strong as ever. Indeed, the whole discussion conveyed the impression that the manufacture of steel by open hearth processes, and in particular by the basic open hearth process is so strongly vested an interest in our own country that those present scarcely deemed consideration of the revival of basic Bessemer steel worthy of discussion at all. As some 3,000,000 to 4,000,000 tons of basic Bessemer steel are annually imported into Great Britain from the Continent every year and actually used for the purposes for which such steel is suited it seems extraordinary that an admittedly cheap and effective process well suited to the local ores of some of our iron mining regions, should be entirely neglected. However, basic Bessemer steel has a bad name with British engineers and hence British manufacturers look askance at any proposal to revive its manufacture at home.

British Insistence on Quality Materials

It is possible that, had Mr. Harbord desired to elicit more than merely a general expression of opinion on the subject, he could have made out a very good case, not only for the revival of the industry, but for the product as well. In this

connection he might have quoted the fact that in 1929 the output of basic Bessemer steel on the Continent represented three-fifths of the entire steel production, no fewer than 21,784,825 tons having been made by the process British engineers and metallurgists will hardly even deign to discuss, out of a total steel production of 34,761,550 tons, a fact that cannot be lightly dismissed merely by the assertion that open hearth steel is a better quality material. The real point seems to be that basic Bessemer steel is quite good enough for Continental engineers to use for a host of purposes where a cheap steel suffices, and that our own insistence on "quality steel precludes the British manufacturer from markets in which price, not quality, is the main consideration, even from the home market which is actually supplied with the cheaper steel, to the disadvantage of the open hearth steel manufac-turer who cannot get rid of the "quality" material he is The Continental output of basic Bessemer steel takes a lot of explaining, in the face of British manufacturers refusing even to discuss the making of such steel at home The Prince of Wales, and other keen observers, seriously. have already emphasised over and over again the fact that many of our customers do not want, invariably, high quality material at a high price and that British material, endeavouring to compete in other markets, too often corresponds with this description and therefore fails to compete with Continental material. Why, it may be asked, do we not make both at home? We use far too much cheap Continental steel in our own country already, to the detriment of our own manufacturers and workers.

Applications of Aluminium and its Alloys

OUR French contemporary Revue de l'Aluminium has adopted a more attractive cover than ever, made from the metal, to the interests of which it is devoted. The contents of the current number are as attractive as its outside, the first article being devoted to the radio-metallurgy of aluminium and of the principal aluminium alloys, while some 26 pages are devoted to the use of aluminium and its alloys in marine construction. This article is by Mr. A. de Biran and goes in considerable detail into the question of the corrosion resistance of the metal to sea water attack, and enumerates the advantages of alpax in this connection. The mechanical and physical properties of typical aluminium-copper (8 per cent. Cu.) and aluminium-copper-zinc alloys are likewise discussed, the latter containing 12 per cent. of zinc and 3 per cent. of copper, while the uses of the copper-silicon alloys of aluminium are also described. Duralumin naturally comes in for a good deal of attention, and there is hardly an application of some or other alloy that fails to find a use in shipbuilding construction, including the hulls of many kinds of vessel. The advance made in aluminium in more purely engineering applications is surprisingly illustrated by the employment of duralumin for such purposes as locomotive crank shafts, which forms the subject of another article. They have been supplied for locomotives on the Chemin de Fer de l'Est, and have given the fullest satisfaction in service

The Influence of the Casting Head

Interesting experiments have been undertaken by A. Courty in order to ascertain the influence of the weight of the head of metal when making castings in aluminium, alpax, and various light alloys of aluminium, as well as of zinc base alloys. The heights of the casting heads were varied from 1 cm. to 20 cms., and the temperature of casting was likewise varied, in each batch of castings, from 578° C. to 750° C. It was found that the fluidity was directly proportional to the This was so, even when the moulds were depth of the head. previously moistened with various liquids, and the explanation is advanced that in such cases the molten metal assumes a spheroidal state which helps it rather than hinders it to maintain its heat, and so assists the flow of metal within the moulds. Solid coatings act in the same way as heat insulators, and indeed, a coating of lamp black was found to assist greatly in maintaining the fluidity of the metal. The earlier experi-ments conducted by the same investigator had already indicated the extent to which added elements assist or impair the

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fluidity of the melt, and therefore of its penetration into the moulds, and the present research links up those results with the temperature conditions, and the degree of pressure due to increasing the head of metal.

High Temperature Nickel-Copper Alloys

RECENT investigations carried out under the auspices of the American Society for Testing Materials and the American Society of Mechanical Engineers Joint Research Committee on effect of temperature on the properties of metals have been concerned with the determination of the high-temperature properties of copper-zinc, copper-zinc-tin, nickel-copper and nickel-cobalt-titanium alloys. The materials slected for study included various types of brass and bronze, Monel metal, Ambrac (nickel 29.4, copper 64, zinc 5.6 per cent.) and Konel (nickel 73, cobalt 17, titanium 2, iron 6.5 per cent.). The tests comprised short-time tensile tests at normal and at raised temperatures, determination of the lowest temperatures of recrystallisation, metallographic examination and long-time creep tests at elevated temperatures. The results are presented in detail for the individual materials and are discussed in relation to chemical composition and the physical condition of the alloys. Attention is directed to the outstanding properties of the high-nickel alloys; in short-time tensile tests it is these alloys which possess the maximum strength over the entire temperature range studied, while the creep test results again show them to possess maximum load-carrying capacity at all temperatures. Konel is stated to possess at 1,000° F. the highest creep-strength value of any material known. On the basis of the results obtained, the conclusion is drawn that the following may be considered safe working temperature ranges for the respective materials under conditions of appreciable stress: Konel, at least $1,000^{\circ}$ F.; Monel, 800° F.; copper-zinc alloys containing 70 per cent. copper, 400° F.; similar alloys which contain 60 per cent.

Nickel Steels for Case Hardening

A RECENT issue of the Revue du Nickel contains a treatise, compiled under the auspices of the Comité d'Etudes du Centre d'Information du Nickel, on the $r\delta le$ of nickel as an element in case hardening steels. The question is theoretically discussed in relation to the iron-carbon constitutional diagram, and attention is drawn to the simplification in heat treatment made possible by the presence of the nickel constituent. In steels containing 3 per cent. or more of nickel a single oil quench from about 1,400° F. forms an adequate substitute for the double heat treatment required by carbon steels, and the alloy steels show, after the simplified treatment, a more uniform and a tougher "case," a more gradual transition from case to core, and improved mechanical properties in the core portion. The adoption of the single quench, together with lessened rejects, saving in straightening operations, and improved machinability, go far to balance, if not to outweigh, the additional cost of the alloy steel, while the all-round superiority of nickel alloy steel case hardened parts, and the possibility of treating more easily large and complicated sections, have led to the very extensive adoption of these steels in large-scale engineering.

The Manganese Situation

In a recent issue of *The Manchester Guardian Commercial* it has been pointed out that the fall of manganese prices to their present very low level is not entirely due to world economic depression, as is the case with other metals and minerals. Statistics available for the average price of 48–50 per cent. manganese ore (per unit c.i.f.), taken at each month throughout the year, show that the fall dates from 1924 when the average price was is. IId. Thence onwards, the average price dropped to the level of is. 9½d. in 1925, to is. 6½d. in 1926, is. 5½d. in 1927, is. 4½d. in 1928, is. 1½d. in 1929, and is. 0½d. in 1930. In April of this year it was 11½d. South Africa is still further suggested as a disturbing factor in the manganese situation, for after several years of negotiations and development, ore from the Postmasburg deposits is now being mined at the rate of 1,000 to 2,000 tons a day. Much of the original development work was carried out by Union Manganese Mines and Minerals (S.A.),

Ltd., in which American capital was chiefly interested, although New Consolidated Goldfields, Ltd., had options over the properties of this company but abandoned them in 1928 largely owing to the financial and transport difficulties. 1929 an agreement was reached between Union Manganese Mines and the British-Swiss International Corporation, and the Manganese Corporation (1929), Ltd., was formed with a capital of £1,000,000, of which £225,000 was allotted to the Union Manganese Mines as purchase price. An agreement was then entered into with the Union Government for the construction of a branch line from Koopmansfontein to Postmasburg, a distance of 60 miles, the company undertaking to ship 200,000 tons of ore in the first year and 300,000 tons in each successive year of the agreement. This railway was completed in the second half of 1930, and provision has been made for extensive ore handling and shipping facilities at Durban. Plans are believed to provide for the export of at least 350,000 tons of ore a year immediately, and it is probable that a ferro-manganese plant will ultimately be constructed at Colenso, near Durban, where cheap power is available. It is said that the ore is of excellent grade, that the mining costs are low in comparison with other world deposits, and that the ore reserves are very extensive. If, therefore, the future output of the company is in the neighbourhood of 1,000,000 tons per year, there seems to be a promising future for the South African manganese industry in spite of the present unsatisfactory position of the market, although it is doubtful if the markets can absorb this tonnage.

Surface Conditions in Springs

British manufacturers of steel springs for locomotive coaches and motor-cars are incorporating into their practice the results recently obtained from the work of the Springs Committee of the Department of Scientific and Industrial Research. This committee was set up to prove or disprove the allegation that certain foreign springs were superior to those made in Britain. Whilst tests carried out at the National Physical Laboratory gave no indication of any superiority of the foreign product, it was found that foreign springs were slightly stiffer than those of British manufacture, and there was also a marked surface weakness which is common to most springs. During the committee's work on British springs, however, it was discovered that through the development of surface weakness, produced in various ways during manufacture, the full intrinsic mechanical properties of a spring steel were never utilised. Material in an unpolished condition as generally used for springs was much weaker—often one-fifth to a half weaker—than when machined and polished. Prior to the work of the committee this fact was apparently unsuspected by steel and spring makers either here or abroad. The differences in the strength of the material in the springs was shown to be due to variations in surface conditions, probably due to decar-burisation during heat treatment. The same variation in strength, it is claimed, applies to any steel in an unmachined or unpolished condition. In view of the importance of this discovery a more detailed investigation into the effect of the surface on the fatigue-resisting properties of steels was arranged. Considerable progress has already been made in this work, and there appears to be a definite promise of developing practical processes which will allow a full fatigue resistance of the material to be obtained without any initial machining operation. The ultimate result should be either a cheaper and lighter spring of the same strength as existing springs, or a stronger spring of the present weight.

Iron and Steel in the United States

According to statistics issued by the American Iron and Steel Institute, the steelmaking capacity of the United States at the end of last year was some 66,900,000 tons, compared with 63,070,000 at the end of 1929. The country's capacity for making pig iron was 51,850,000 tons at the end of 1930, against 50,920,000 tons at the end of the previous year. At the present time the rate of operations in the steel industry approximates to 47 per cent. of productive capacity. Although the general decline in the demand for steel shows signs of continuing it is meeting increased resistance. Activity in the structural steel department is still the most noteworthy feature of the market. The production of pig iron is being curtailed as stocks develop.

Trade, Commerce, Finance: The Month in Review From Our Market Correspondent

WITH the best will in the world, it is impossible to find anything good or cheerful to report about the iron and steel trade during the month of May. Instead, one is compelled to repeat the story of depression and shortage of orders which has been the unsatisfactory record of so many months past. as in April, the holidays may be adduced as a slight excuse for a hold-up of business, but the Whitsuntide stoppage was for a day or two only, and nothing like so extensive as the Easter stoppage. Nevertheless the holiday was not without an adverse influence, as there was a noticeable slowing down in the previous week; and, unfortunately, since the resumption, there has been no fresh activity to make up the arrears. Orders did not accumulate during the holiday, and most of the mills had a very lean programme on which to start work. In an attempt to put the best side out, one might say that there is a little more inquiry and an inclination on say that there is a fittle hole inquiry and an inclination of the part of buyers to make some forward purchases, but that tendency will have to develop much more extensively before it has any vivifying effect on the industry. At any rate, we may hope that it is the beginning of an upward movement, which, according to some eminent economists, is bound to set in before many months are over. The need for it is urgent, very urgent, as everyone connected with the trade knows

Iron and Steel Markets Weaker

In every section of the iron and steel markets a weaker tendency has developed during the past month. To begin with pig iron, the Central Pig Iron Producers' Association, which controls the supply in the Midlands, made a reduction of 2s. 6d. per ton for part of their area and 5s. per ton for the remainder, about the middle of May. One reason given was the competition of continental pig iron, although little of this had been bought. A more likely reason was the desire to induce buyers to come into the market, and it is doubtful whether this object has been achieved. The Cleveland makers will probably have to revise their prices to meet this move, as the Midland makers are still invading the Cleveland markets. There is little or no sale for basic pig iron, as most users have large stocks. In the isolated instances where this quality has been sold, the price has been determined by that at which Indian iron is being offered in this country, which means a price considerably below the home cost of production. hematite makers have had to give way on their determination to make no further reductions. The cause may lie in the restarting of two furnaces at the Ayresome Ironworks, as this additional output can only be disposed of by some attraction in price. Whatever the real reason may be, there has within the last few days been a fall of 2s. per ton in hematite, once more confirming the wisdom of those buyers who, for some months past, have refrained from making contracts but have taken their requirements at current prices

"Orders at Any Price"

Coming to semi-finished steel, a similar story has to be told. In the early part of the month a reduction of 10s. per ton was made in the controlled price of hard basic billets over 0.42 carbon, which makes the basis price for this quality £6 12s. 6d. per ton. Soft billets, that is below 0.42 carbon, are being sold at £5 12s. 6d., and it would not be surprising to hear that £5 10s. had been accepted in some instances. That price, as one might guess, is not an indication of a correspondingly low production cost, but is rather the outcome of the efforts made by individual makers to invade each other's territory. It is very disheartening to think of the manner in which business is being spoiled by this useless competition. Finished steel is no exception to the rule, as far as the uncontrolled materials are concerned. Small steel bars are now being freely quoted at £6 15s, per ton, the steel offered being described as British. One cannot imagine re-rollers buying British billets and rolling them into small bars to sell at that price; and it is equally improbable that any steel makers can produce bars from his own billets at a cost which will enable him to deliver at £6 15s. "Orders at any price" is evidently still the motto.

Boiler plates have not changed much, but £8 15s. seems to be a general price at present. The price of controlled materials, plates, angles and joists, cannot be altered before the associated steel makers hold their joint meeting in July, but as things are going there is little doubt that a reduction will be made. One section of the makers was strongly in favour of a reduction at the last meeting, and they will be strengthened in their attitude by the representations which are being made by the Central Board of the Shipbuilding Employers' Federation. At a meeting held on May 29 the Federation had under consideration the prices charged for British steel under the rebate scheme. When this scheme was first started, the disparity between foreign and home prices was not very great, but since then it has widened so much that the rebate of 15s. per ton is less than half the difference. The shipbuilders are therefore making strong demand for further concessions, which it will be difficult to resist. What with falling prices and receding outputs, the lot of the steel maker is an unenviable one.

Developments in Governmental Control

There has been a further development of the matter of Governmental control of the industry, to which reference was made in last month's report. The trade unions are now taking a hand in it, probably not of their own volition, but in response to promptings from official quarters. How other can one explain the change of face? Not many weeks ago some of the chief executive officials of the Iron and Steel Trades Confederation were loudly insistent in their demand for protection for the steel trade, while now that demand has tapered down into a very half-hearted request for a sort of conditional safeguarding. The sequence of recent activities might be summarised as follows. Most of the large steel works, by reason of their overdrafts, are in the hands of the banks. The banks, no doubt, alarmed about the value of their security in this long drawn out depression, have had a report drawn up by the managing director of the Bankers' Industrial Development Co., advocating the regional re-organisation of the industry throughout the kingdom. The Government have seen this report, and probably at the instigation of the bankers have adopted it as the basis of their policy for the control of the industry. Lacking the authority from the country, they have brought in the steel workers trade union to pass resolutions in favour of the scheme. we may look forward to the introduction of the Iron and Steel Bill later on in the year. There are many criticisms of the scheme which might be put forward, but unfortunately the steel makers seem to have no voice in the matter, and unless there is a sudden turn in the tide, bringing a very definite revival in trade, which might shelve the whole business, there is every prospect of the freedom of the industry being lost.

Views of Executive Councils

It has to be admitted that the statement drawn up by the Executive Council of the Iron and Steel Trades Confederation, representing the workers, is a well reasoned and forceful document, but it is spoiled by the inclusion of a demand for legislative authority to bring the industry within the control of a public utility corporation with a central management board. The National Federation of Iron and Steel Makers, in their reply to the statement, express their agreement with much of the statement, and point out that the regional organisation advocated has already made substantial progress in every district, and was really initiated by the industry itself. They again lay emphasis on the necessity of protection for the home market and relief from the burden of excessive taxation. They are, however, definitely opposed to State control in any form. The further course of this matter will be closely and anxiously followed.

The April output figures show a further decline. Pig iron amounted to 323,200 tons, compared with 357,100 tons in March, the number of furnaces in blast being three less. Steel production was only 397,400 tons, compared with 500,100 tons in March.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Alloy Steels

A process for producing in an electric furnace alloy steels containing one or more of the metals tungsten, chromium, molybdenum, and vanadium is described in Specification 343,700, dated January 21, 1930, by C. Arnold, of Kalk, Cologne, Germany. The molten iron is first freed from phosphorus and sulphur by a fluorine-containing slag. This slag is then removed, and a slag free from fluorine is added before the addition of the alloying metals. This second slag is a meta-silicate of an alkaline-earth metal or magnesium or a mixture thereof, with or without a further admixture of alkali meta-silicates.

Coating with Metals

In the formation of metal coatings in a vacuum a metal of high vapour pressure such as magnesium, aluminium, iron, cobalt, calcium, or mercury is first deposited by sublimation, and the deposited metal is then caused to react with a volatile compound of a metal which is electronegative to the deposited metal, e.g., nickel, copper, tungsten, chromium, or arsenic. A layer of the second metal is thus p.oduced. In an example, magnesium deposited by sublimation is heated in nickel chloride vapour to produce a layer of nickel, from which the magnesium chloride formed may be removed by distillation or by washing with suitable solvents. The process is applicable for coating cathodes of electron discharge apparatus, surfaces of vacuum flasks, electric condenser surfaces, and electric resistances. See Specification 343.875, Interrational Convention date October 13, 1928, by B. Loewe, of Berlin.

Copper

COPPER ALLOYS containing tin, antimony, or arsenic are difficult to resolve into their constituents. According to Specification 341,889, International Convention date October 20, 1928, by W. Kroll, of Luxemburg and Huttenwerke Trotha Akt.-Ges., of Halle-Trotha, Germany, such resolution is effected by treatment with silicon in presence of lead, whereby a layer of copper silicide free from other constituents separates. The lead, e.g., as the metal, oxide, or carbonate, may be added with the silicon, which is preferably high grade, e.g., 95 per cent., but may be in the form of ferro-silicon or commercial silicides. Alternatively, the silicon may be introduced by reducing silicon compounds with sodium or carbon.

Iron Alloys

IRON ALLOYS resistant to corrosion by mineral acids are described in Specification 343,745, dated February 19, 1930, by W. E. Dennison, of Hull. They are obtained from cast iron containing not less than 3 per cent. of carbon and 1.5 per cent. of silicon by adding 0.5-2 per cent. of copper and 0.25-0.75 per cent. of chromium. The chromium content is in any case not higher than the copper content. Small quantities of titanium, vanadium, and like alloying metals may also be present. The chromium and the copper may be added in the ladle or in the furnace or cupola, and the chromium may be in the form of ferro-chrome containing 30 per cent. of chromium.

Iron Castings

Castings containing super-eutectic carbon in an extremely fine state of division in a sorbo-pearlitic matrix of fine grain are obtained from a high-carbon iron containing 1·25—2·25 per cent. of silicon by melting, quenching by chill-casting, wet-casting or the like to cause it to solidify at least partly white, heating to 900–1,050° C., and allowing to cool. The quality of the castings may be improved by incorporating nickel and/or chromium with the iron. See Specification 341,436, dated September 10, 1929, by E. Piwowarsky, of Aachen, Germany.

Metal Sponge

To produce a metal sponge, e.g., a sponge of iron, cobalt, chromium, nickel, or chrome iron, without fusion of the ore or metal, the finely divided ore is intimately mixed with a carbonaceous and/or a thermic reducing agent in excess of the

amount!required for the complete reduction, the mixture is formed into briquettes or like agglomerations, and the reduction is effected in a shaft or rotary furnace by heat given off by combustion gases such that they burn at least a part of the excess of reducing agent. Such excess reducing agent may be in the form of powdered coal applied to the surfaces of the briquettes, etc., before they are dried. Processes and plant for effecting the reduction in shaft and rotary furnaces are described and illustrated in detail. Specified thermic reducing agents are ferro-silicon, ferro-aluminium, terro-aluminium.silicon, and aluminium. See Specification 343,954, International Convention date November 28, 1928, by E. G. T. Gustafsson, of Stockholm, Sweden.

Refining Iron or Steel

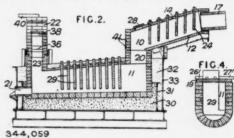
Processes for refining iron or steel by the introduction of gaseous or liquid reagents into the molten metal are described in Specifications 341,873 and 341,915, International Convention dates June 11 and June 18, 1929, respectively, by F. Krupp Akt.-Ges. Friedrich-Alfred-Hütte, of Rheinhausen, Germany.

341,873. Gaseous or liquid reagents are introduced into molten material, such as pig iron, through pipes which are raised and lowered periodically while the reagent is passing, thus causing some of the melt to adhere to the pipe, forming a protective layer. The pipes are preferably covered with asbestos cord.

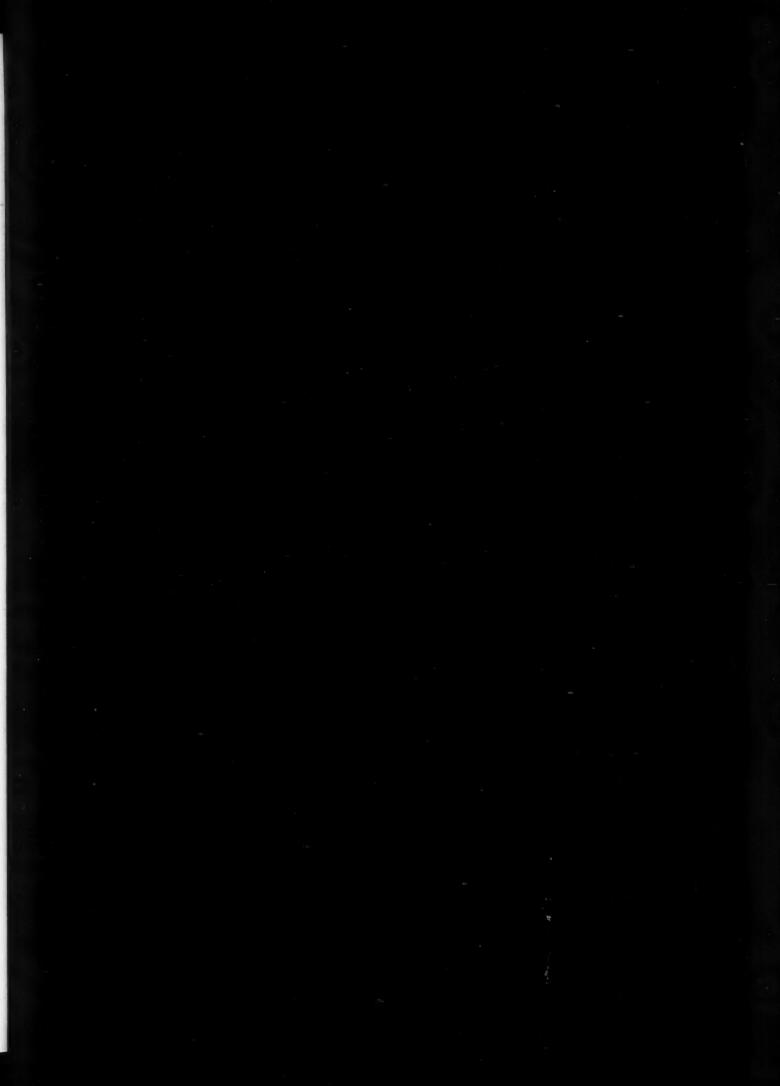
341,915. In refining iron or steel by the introduction of water into the molten metal through pipes as described in Specification 317,373 (see The Chemical Age, Vol. XXI, (Metallurgical Section), p. 37) the pipes are provided with a protective layer of liquid slag prior to or during the refining operation. The water may be introduced into the bath through a slag-coated billet of the metal to be refined provided with a longitudinal bore in one end of which is screwed the water supply pipe; in this case the high thermal capacity of the billet affords further protection.

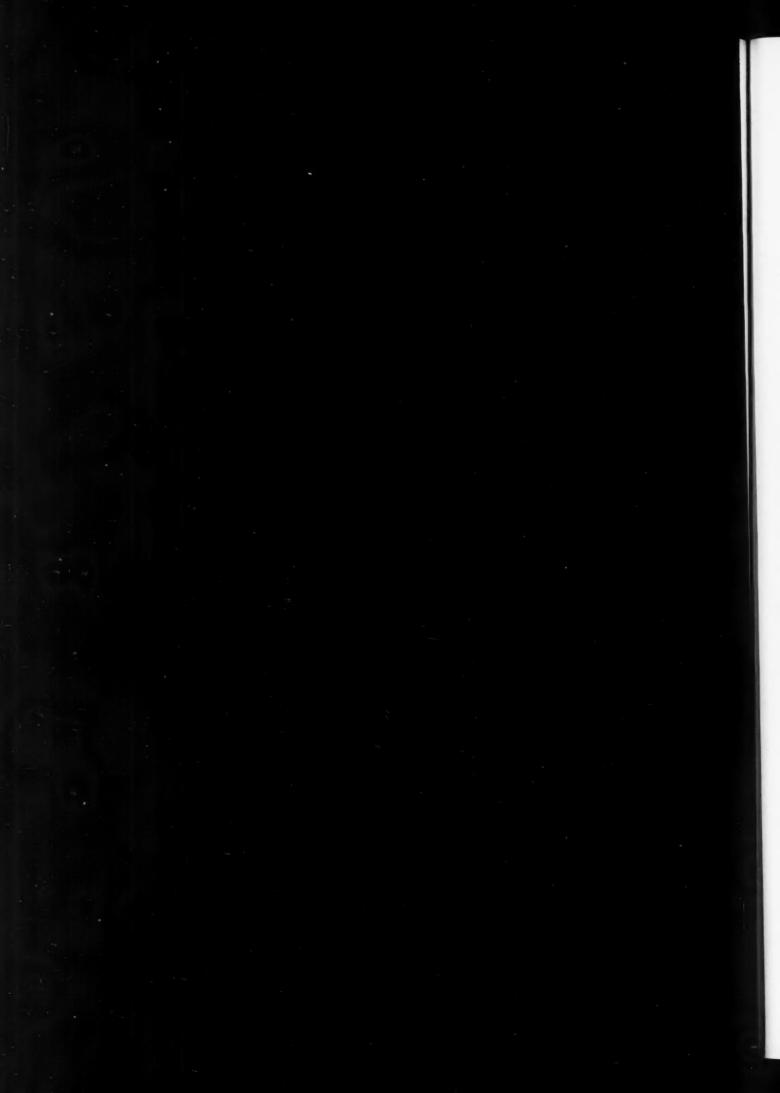
Zinc

A process and apparatus for condensing zinc vapour are described in Specification 344,059, International Convention date October 16, 1929, by New Jersey Zinc Co., of New York, Assignees of E. H. Bunce, of Palmerston, Pennsylvania, U.S.A. A stream of gas carrying the vapour, e.g., from a smelting or redistillation furnace, passes through a passage 17, Fig. 2, into a condensing chamber 10 formed of tiles 12, 14, preferably of silicon carbide, fitted with adjustable baffles 24 arranged to give the stream a tortuous side-to-side path through the chamber. The rate of heat dissipation from the chamber may



be controlled by the adjustment of heat insulating material around the chamber. According to the invention the conditions of heat dissipation are such that the zinc vapour is rapidly cooled in the chamber 10 to below the dewpoint, but insufficiently to cause solidification of the molten zinc which flows through the chamber concurrently with the gaseous stream, but by a shorter path, into a collecting sump 11, in which the gases are cooled more slowly than in the chamber 10. This sump is U-shaped and provided with adjustable spaced baffles 29, shaped as shown in Fig. 4 and arranged to give a tortuous path to the gas stream. The molten zinc is withdrawn at intervals from a tap hole 21, and the gases pass by way of a short vertical passage 23 and a transverse passage to an exhaust stack 22, of which the exit is higher than the inlet from the passage 17, in order to maintain a down draught through the chambers 10 and 11. The cooling of the gases in the chamber 10 is from 800-900° C. to 550-650° C, and the further cooling in the sump 11 is to 500-600° C.

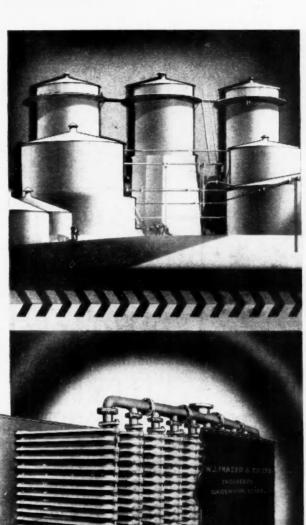


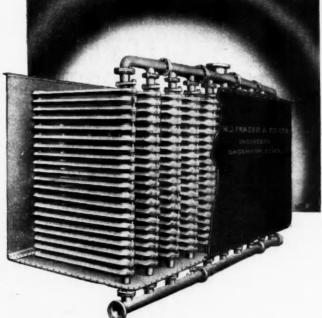




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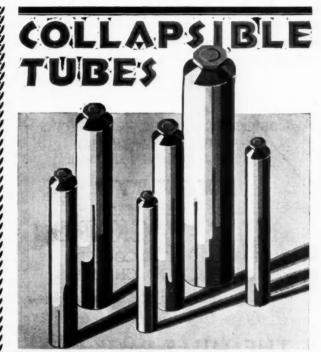
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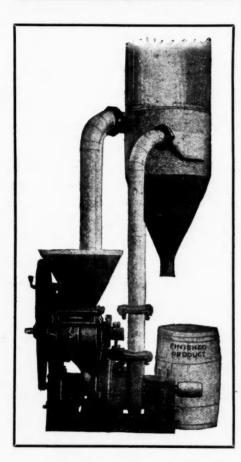
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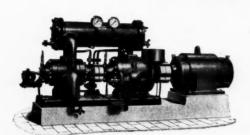
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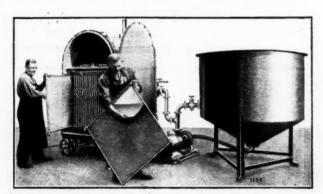
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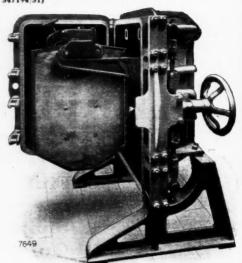
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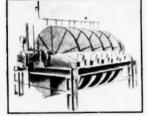
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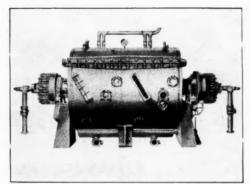
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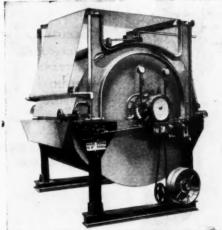
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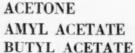
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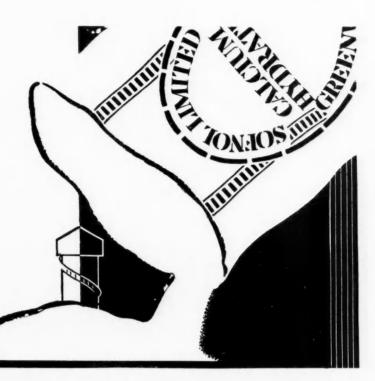
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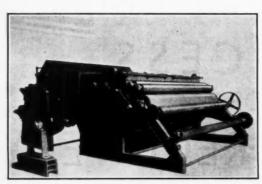
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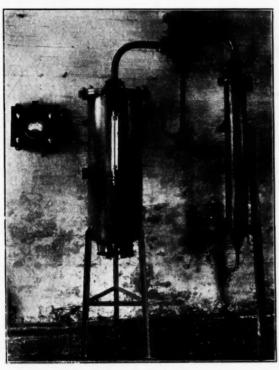
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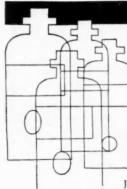
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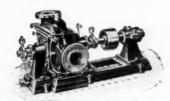
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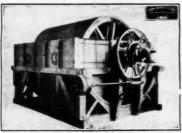
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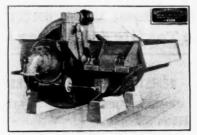
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